ORGANIZATIONAL CONCEPTS FOR THE "SENSOR-TO-SHOOTER" WORLD: THE IMPACT OF REAL-TIME INFORMATION ON AIRPOWER TARGETING

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Abstract

Two terms should be understood from the start: Real-Time Information into the Cockpit and Military Technical Revolution. RTIC involves systems capabilities required to provide aircrews timely and essential off-board information to allow mission adjustments in response to rapidly changing combat conditions. An MTR requires *converging* technological products which have a *demonstrated* military utility, and military recognition that the application of these converging technologies will cause a *radical change in the character of warfare over a very short period of time.*

RTIC does not foreshadow a coming MTR although it does employ converging technological products which have a demonstrated military utility. RTIC is not likely to cause radical change to the character of warfare. Nonetheless, it improves a commander's ability to employ operational art—to *employ* military forces to attain strategic and/or operational objectives through the design, *organization, integration, and conduct* of strategies, campaigns, *major operations, and battles.*

This thesis assesses the capabilities of RTIC from two perspectives: its impact on the air tasking process, and the command and control flexibility it affords the Joint Force Air Component Commander. It concludes the impact on the air tasking process is evolutionary, not revolutionary—current RTIC capabilities remain largely dependent on human-intensive operations which limit reductions in decision cycle times. It further suggests that RTIC's true impact on targeting is directly attributable to the increased flexibility provided to the Joint Force Air Component Commander (JFACC) for prosecuting the execution-day air tasking order (ATO).

Chapter 1

Introduction

Due to battlefield dynamics, the JFACC/JFC (Joint Force Air Component Commander/Joint Force Commander) may be required to make changes to the planned joint air operations during execution.

—Joint Pub 3-56.1
Command and Control for Joint Air Operations

Today's Situation. U-2 signals intelligence equipment picks up an active enemy air defense radar. These signals cue the U-2's Advanced Synthetic Aperture Radar System to image the area. Data is sent to ground processing systems and three hours later[1] the finished product arrives in the hands of the JFACC at the Air Operations Center. Evaluation of the images indicates fixed and mobile surface-to-surface Scud missile launchers in the area. The decision to attack the Scuds is passed from the JFACC to flights of F-15Es through the Airborne Command, Control, and Communications (ABCCC) aircraft. The fixed Scud launchers are destroyed, however, the mobile launchers had moved long before the F-15s arrived in the area.

Tomorrow's Situation. A Defense Support Program (DSP) satellite identifies a ballistic missile launch. Coordinates of a launch ellipse are immediately data-linked to an on-orbit RC-135 Rivet Joint. Rivet Joint sensors refine the launch coordinates in seconds. Precise coordinates are simultaneously transmitted to an RTIC (Real-Time Information into the Cockpit) cell within the Combat Operations Division of the AOC and to an

orbiting Joint Surveillance Target Attack Radar System (JSTARS) aircraft. JSTARS tracks the Scud launchers[2] as they move from their launch locations. Meanwhile, the RTIC cell identifies an adequately configured strike package enroute to another target and redirects it to attack the launchers. The redirection uses both secure-voice transmissions to alert the affected crews, and a direct data-link to pass vital mission information. This mission information includes an updated flight route, current target-area weather, revised threat information along the new flight path, photographs of recently targeted Scud TELs (transporter, erector, launchers), and continuously updated sets of latitude, longitude, and elevation for the moving TELs. Within minutes, the F-15s acquire radar contact with objects in the reported TEL location, use their LANTIRN systems to visually identify the objects as Scud launchers, and moments later, employ their weapons on the doomed targets—the strike is successful and once again the US has transformed information into combat power.

RTIC—Real-Time Information into the Cockpit—is a new buzzword in the Air Force vernacular. Along with its parent phrase, sensor-to-shooter, RTIC deals with the "systems capabilities required to provide aircrews timely and essential off-board information to allow mission adjustments in response to rapidly changing combat conditions."[3] The essence of RTIC is flexibility, and flexibility is a tenet of airpower equal with centralized control.[4] At issue is the synergy that arises from the application of RTIC technology in an environment of centralized command. More specifically, the RTIC flexibility made possible by current technologies combined with the unity of command embodied in today's JFACC has matured sufficiently to warrant changes to the existing command and control (C^2) architecture laid out in Air Force and joint doctrine.

This thesis explores organizational concepts for an RTIC environment that is available today. Its focus is on increasing JFACC flexibility by applying real-time information to airpower targeting. A look at the air tasking process as established in current joint doctrine[5] and employed during the Gulf War provides the foundation for this analysis of near-term RTIC possibilities. It also helps set the boundaries of what this thesis is as well as what it is not. It *is* an examination of C^2 organizational architectures that could be employed near-term, i.e., well within a decade. As such, it explores RTIC as a capability that supplements the air tasking process, but does not replace it. It is oriented toward, though not confined to, air-to-ground actions performed by limited sets of weapon platforms[6] operating beyond the close battle. Additionally, it is a reaffirmation of the value of unity of *airpower* command[7] employed by today's JFACC. It is not a proposal to rewrite the first of Air Force Manual 1-1's "Tenets of Aerospace Power"[8] as *De-*Centralized Control/Decentralized Execution; rather, it is an investigation aimed at enhancing the airpower flexibility available in an appropriately centralized command and control architecture.

The centralized control and decentralized execution of the Gulf War air campaign—its planning, tasking, and execution of an average 2,847 sorties per day[9]—worked well. Though not error-free, the C^2 team from the JFACC, Lieutenant General Charles A. Horner, through the Tactical Air Control System[10] "spectacularly outperform[ed] the best team of leaders Iraq could put in the field."[11] Why do we have a JFACC today and why did the JFACC C^2 concept work so well in the Gulf War? The JFACC concept is largely a response to the numerous tactical victories and strategic defeat experienced in Vietnam. Lack of unified command in air operations in Southeast Asia was arguably a key

consideration leading to the JFACC concept as outlined in the Goldwater-Nichols Act,[12] JCS Pub 26, *Joint Doctrine for Theater Counterair Operations*,[13] and the current Joint Pub 3-56.1, *Command and Control for Joint Air Operations*.[14] Refinement of the JFACC concept came to fruition in Desert Storm. Gen Horner's command and control was effective for a number of reasons. The capability of Gen Horner's Tactical Air Control System to convert JFC guidance into explicit aircraft missions was a principal reason. More precisely, the Tactical Air Control Center's[15] ability to control the sorties in today's war while coordinating the specific missions for tomorrow's war was crucial to the success of the JFACC C^2.

Although it can be argued that the current C^2 approach to airpower has not been stressed, it seems to be a logical extension of the theoretically and historically sound tenet of centralized control. Today's notional JFACC fights the air portion of the theater campaign primarily through his AOC[16] which disseminates targeting and other guidance via the Air Tasking Order (ATO).[17] The Combat Operations Division of the AOC, through a number of channels, can add, delete, or modify missions on the current-day ATO. Combat Operations may add or delete sorties through direct unit contact. They may alter airborne missions through ABCCC or AWACS (Airborne Warning and Control Systems aircraft).

RTIC offers a much improved ability to modify missions and a correspondingly enhanced C^2 flexibility for the modern JFACC. US reconnaissance and sensor capabilities are tremendous. Likewise, US information processing and information flow capabilities are extraordinary and available, though many are not yet operational. These sensor and information transfer capabilities tied with current fighter and weapons technologies offer

capabilities to today's JFACC that were only imagined by the warriors of Desert Storm. They can provide an advantage in "observation-orientation-decision-action" (OODA)[18] cycle times over any available to potential adversaries. An appropriate C^2 architecture, however, is needed to fully exploit the capabilities presented by RTIC.

This thesis provides a three-pronged analysis to identify an organizational structure that can properly engage RTIC possibilities and take full advantage of the impact that real-time and near real-time (NRT) information into the cockpit can have on airpower targeting. The first two portions of this analysis explore the current air tasking process and describe the capabilities of today's sensors, information processing, data-links, and shooters. The third segment examines a fusion of the two.

Chapter 2 examines the current air tasking process. An understanding of joint air operations development, plans and the planning process, targeting, the air tasking cycle, and the C^4I requirements necessary to link these together provides the foundation for further RTIC analysis. Understanding today's air tasking process in the context of AOC operations provides a basis for exploring JFACC flexibility needs, and presents one half of the background needed to understand the potential offered by RTIC.

Chapter 3 explores the second half of this background—current capabilities. It provides descriptions of current US reconnaissance systems and information transfer abilities. This section describes several recent demonstrations of sensor-to-shooter capabilities that bear directly on RTIC organizational structures. It presents the nodes of the Theater Air Control System (TACS)—specifically, the reconnaissance sensors and weapon systems—and the C^2 structure that links these together to point out the potential

of RTIC and the need for a revised C^2 architecture. The chapter closes by affirming the continuing need for centralized C^2 with decentralized execution.

Chapter 4 articulates the advantages gained by superimposing the sensor-to-shooter features described in the third chapter over portions of the current air tasking process detailed in the second chapter. It also defines organizational changes that will enable the supposed "*real-time* central control, coordination, and integration of ongoing air operations"[19] ascribed to the Gulf War to actually take place in real time.

Finally, Chapter 5 moves slightly beyond the thesis' self-imposed confines laid out in the beginning of this chapter, and briefly looks at RTIC architecture possibilities beyond the near-term future.

Notes

1. The significance of this time is that it is measured in hours, not seconds or minutes. Three hours represents a realistic period for processing and transmitting U-2 material. Actual processing times, however, are classified. Interview with Capt Daniel E. Johnson, Combined Imagery Exploitation Facility (CIEF) Operations Officer, Warrant Officer Michael E. Waliohn, Canadian Forces CIEF NCOIC, and TSgt David A Grubbs, CIEF Team B Exploitation NCOIC, Combined Intelligence Center, Peterson AFB, CO, 4-5 April 1996.

2. JSTARS combines synthetic aperture radar (SAR) imaging with moving target indicator (MTI) data to provide high-resolution radar images. This allows JSTARS crews to differentiate between stopped vehicles and moving traffic. Furthermore, crews can determine whether vehicles are wheeled or tracked by measuring Doppler signatures from the advancing and receding treads of individual vehicles. Current Bosnian missions use such high-resolution radar images to typically scan areas as small as 2 X 4 kilometers (1.2 X 2.5 nautical miles) in size. DSP and Rivet Joint-supplied coordinates of a Scud launch ellipse allow JSTARS crews to focus their efforts in such a small area, and track specific vehicles found within this area. Craig Covault "Joint-STARS Patrols Bosnia." *Aviation Week & Space Technology* (19 February 1996): 48-49. Interview with Major Christopher H. Frasier, 11th Space Warning Squadron, Falcon AFB, CO, 4 January 1996.

3. Combat Air Forces Mission Need Statement 315-92, *Mission Need Statement for Real-Time Information in the Cockpit (RTIC)*, 26 April 1994.

4. Air Force Manual 1-1, Volume I, *Basic Aerospace Doctrine of the United States Air Force*, March 1992, 8.

Notes

5. Primarily Joint Pub 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994.

6. Cost considerations immediately negate any notion of all fighter, bomber, and attack aircraft being fully equipped to perform RTIC missions—those requiring off-board voice and data information for retargeting. Much of the RTIC capability available in the near-term is oriented toward multi-seat aircraft employing precision guided munitions (PGMs), or single-seat PGM-capable aircraft that remain survivable at medium to high altitude in all threat environments. RTIC capabilities allowing workloads that do not compromise pilot safety during low-altitude, high-threat missions that may entail PGM retargeting will likely be unavailable in the near term. F-15E, F-117, and PGM-capable B-1 and B-2 aircraft would be well suited for RTIC missions.

7. This is a slight adaptation of the Unity of Command principle of war, defined as "Ensur[ing] unity of effort for every objective under one responsible commander," found in Air Force Manual 1-1, Volume I, 1.

8. Air Force Manual 1-1, Volume I, 8.

9. Gulf War Air Power Survey Volume I Part II, *Command and Control Report*, March 1993, 7.

10. Now referred to as the Theater Air Control System.

11. Gulf War Air Power Survey Volume I Part II, 329.

12. Formally entitled The Department of Defense Reorganization Act of 1986.

13. JCS Pub 26, *Joint Doctrine for Theater Counterair Operations*, resulted from a Joint Doctrine Pilot Program established in 1982 by the Joint Chiefs. In 1985, the Commander in Chief of the European Command (CINCEUR) formally submitted to the Chiefs a joint doctrine for theater counterair operations. One element of this proposed doctrine was the concept of the Joint Force Air Component Commander, an officer appointed by the theater or Joint Force Commander to plan and coordinate a jointly fought air campaign. On 21 February 1986, the Chiefs approved CINCEUR's proposal as JCS Publication 26.

14. Joint Pub 3-56.1, provides fundamental principles and doctrine for the command and control of joint air operations throughout the range of military operations. It lays out JFACC responsibilities and a notional JFACC organization.

15. The TACC of the Gulf War is today's Air Operations Center (AOC).

16. AOC, Joint AOC (JAOC), or Combined AOC (CAOC).

17. The acronym ATO is used throughout this thesis to nominally represent the Air Tasking Order as used during Operation Desert Storm as well as tasking directives such as the Integrated Tasking Order (ITO) used by US Forces Korea and the Air Tasking Message (ATM) used during Operation Deliberate Force in Bosnia.

18. Colonel John R. Boyd contends that all rational human behavior, individual or organizational, can be depicted as a continual cycling through four distinct tasks—observation, orientation, decision, and action. Boyd refers to this decision-making cycle as the "OODA loop." Using this construct, the crux of winning vice losing becomes the relational movement of opponents through their respective OODA loops. The winner will be he who repeatedly observes, orients, decides, and acts more rapidly (and accurately)

than his enemy. John R. Boyd, "A Discourse on Winning and Losing," August 1987. A collection of unpublished briefings and essays. Air University Library, Document No. M-U 30352-16 no. 7791, 2. Major David S. Fadok, *John Boyd and John Warden: Air Power's Quest for Strategic Paralysis*. Maxwell AFB, AL: Air University Press, February 1995, 16.

19. Gulf War Air Power Survey Volume I Part II, 139. [Italics added.]

Chapter 2

The Air Tasking Process Today

> *The campaign objective, together with its relationships to strategic and tactical objectives, is the paramount consideration in every campaign. . . . Orchestration of aerospace missions into an effective campaign in the face of peculiar and often rapidly changing situations comprises the airman's operational art.*
>
> —Air Force Manual 1-1 Volume I
> Basic Aerospace Doctrine of the United States Air Force

The air tasking *process* begins with planning at the strategic level. Strategic objectives connect to tactical force employment through planning at the operational level which focuses on operational art—the employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles.[1] This process concludes at the tactical level with the employment of units in combat.

Knowledge of five areas within this overarching air tasking process is critical to an understanding of the full process. First, the overall concept of joint air operations development involves the translation of the joint force mission into a joint air operations plan. Second, this plan and the planning process encompass research into the operational environment, the determination of objectives, the identification of a clearly defined strategy, and an assessment of center(s) of gravity. Third, a joint targeting process matches the objectives and guidance promulgated in the JFACC's plan with inputs from

intelligence and operations personnel to select specific targets and target sets, and to identify the forces needed to achieve desired objectives against those targets. Fourth, a joint air tasking cycle provides for the effective and efficient employment of available air assets. Fifth, appropriate command, control, communications, computers, and intelligence (C^4I) resources provide the connectivity to ensure the air tasking process is not simply a linear process, beginning with the JFC's theater campaign plan and ending with bombs on target, but a cyclical one involving constant feedback and continuously updated taskings. Further discussion of these five areas will clarify the air tasking process in total.

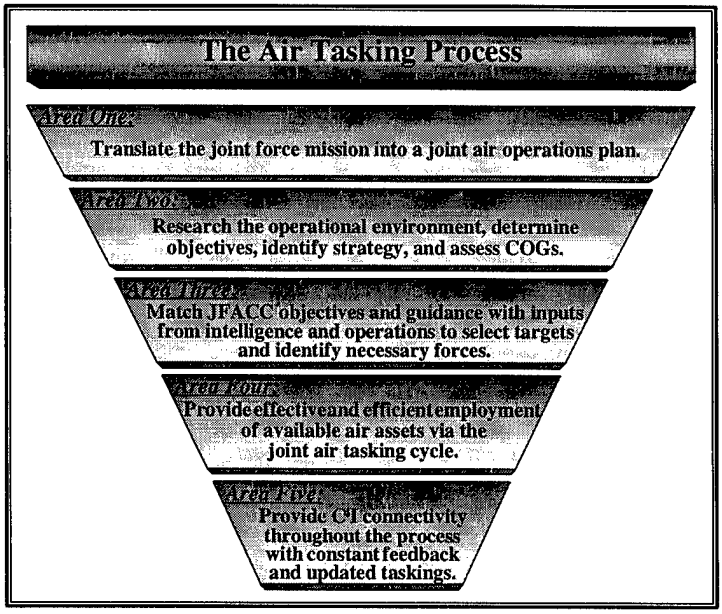


Figure 1. The Air Tasking Process

Concept of Joint Air Operations Development

Planning for joint air operations begins with understanding the joint force mission.[2] The JFC's mission statement expresses what the joint force must accomplish and why. It is the driving force for all detailed planning that follows, and is based on the commander's strategic appreciation of the various factors—political, economic, military, and social—

affecting his area of responsibility (AOR).[3] It is also the articulation of the strategic and operational objectives needed to accomplish the mission and forms the basis for determining components' objectives.

The JFACC uses the JFC mission, strategic appreciation, and objectives to devise an estimate of the situation and an appropriate concept of air operations. This concept of air operations bridges the gap between JFC-delineated objectives and the formulation of a course of action (COA). When the JFACC's COA is approved by the JFC, it becomes the basic concept for subsequent air operations and states "what" will be done. "How" is laid out in the joint air operations plan and supporting plans such as the master air attack plan (MAAP), the air defense plan, and the airspace control plan. The JFACC provides daily guidance to the AOC to ensure air operations effectively support the joint force objectives while retaining sufficient flexibility to adjust to the dynamics inherent in military operations. AOC personnel use this guidance to continually refine the MAAP and supporting orders, specifically, the air operations order, the airspace control order, and the air tasking order. The ATO provides the primary vehicle for disseminating the "who," "when," and "where" of joint air operations while the AOC maintains responsibility for updates and revisions to the current-day, or execution-day, ATO. This ATO, however, in not *the* plan, but one product in the air operations planning process.

Joint Air Operations Plans and the Planning Process

The JFC normally assigns a JFACC responsibility for joint air operations planning.[4] The JFACC, in turn, develops a joint air operations plan to employ that portion of the air

effort made available to him for accomplishing the JFC's objectives. This plan documents the JFACC's scheme for integrating and coordinating joint air operations.

Five phases—operational environment research, objective determination, strategy identification, center(s) of gravity identification, and the joint air operations plan development—make up the normal joint air operations planning process. Though the phases are not required to be completed in order, each phase produces an end product, and at some point, the phases must be integrated and the products of each phase must be verified for coherence. The final product is the joint air operations plan which details how joint air operations integrate with and support the JFC's theater campaign plan.

The first phase, *operational environment research*, applies Sun Tzu's dictum "Know the enemy and know yourself; in a hundred battles you will never be in peril."[5] Today's phrase for Sun Tzu's maxim, and the product of this phase, is intelligence preparation of the battlespace or IPB. Operational environment research, like IPB, focuses on gaining information about both friendly and enemy capabilities, intentions, and doctrine, and the environment in which the operations will take place in order to reduce uncertainties. Its intent is to maximize understanding of the opponent, the theater of operations, and the friendly forces available to accomplish the JFC's objective.

Phase two, *objective determination*, is arguably the most crucial of the five phases. Clearly defined and quantifiable objectives that contribute to the accomplishment of the JFC's operation result from this phase. These joint air objectives flow from the JFC's objectives and should complement other components' objectives. More than land and maritime power, airpower in conjunction with the exploitation of space-based systems can directly impact the strategic level of war and can do so in an integrated or independent

manner, simultaneously or sequentially. The air objectives at each level must support the objectives of the higher level, and ultimately support the JFC's objectives to ensure unity of effort.

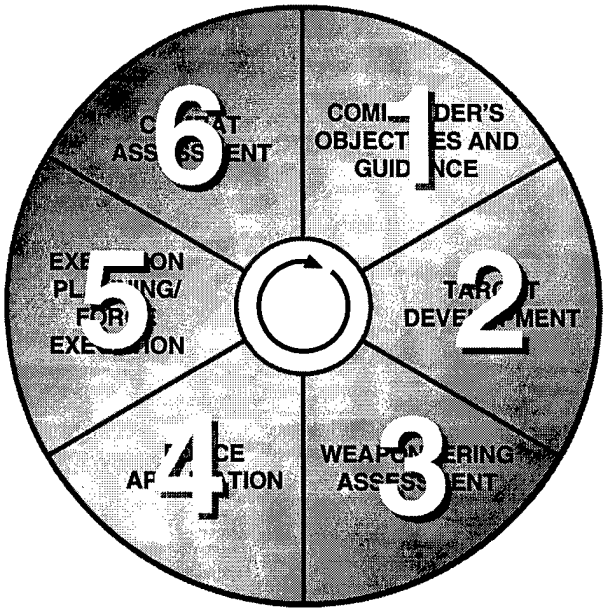
Phase three, *strategy identification*, produces a clearly defined joint air strategy statement. The strategy states how the JFACC plans to exploit joint air capabilities and forces to support the theater objectives of the JFC. The joint air operations plan is how the JFACC communicates, promulgates, and articulates this strategy.

Phase four involves *center(s) of gravity identification.* Carl von Clausewitz defines COGs as "the hub of all power and movement, on which everything depends. . . . the point against which all our energies should be directed."[6] Joint Pub 1-02 updates the definition slightly stating that centers of gravity are "Those characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength, or will to fight."[7] Both definitions point to the desired product of this phase—the identification of those enemy COGs that could be defeated to satisfy the JFC's strategic, operational, and tactical objectives and those friendly COGs to be defended. The COGs of interest to the JFC and JFACC are those that, if defeated, may have the most decisive results. Airpower has a unique ability to attack many of the COGs from the third dimension throughout the AOR, to engage target sets associated with each COG, and to engage these targets simultaneously as well as sequentially.

The fifth and final phase of the planning process, *joint air operations plan development*, delivers the actual air operations plan detailing how joint air operations support the JFC's campaign plan. This plan is based on JFC guidance. It integrates the air effort in achieving JFC objectives. It accounts for current and potential enemy

offensive and defensive threats. The plan indicates necessary phasing of air operations in relation to the JFC's operational phasing and in relation to specific air phases. The plan identifies objectives and targets by priority order, describing the order in which they should be attacked, the desired results, and the weight of effort required to achieve expected results. It details the capabilities and forces needed to achieve the previously determined objectives, and also accounts for systems analysis to identify specific targets that should be reattacked to meet the objectives.

Targeting: The Process and Responsibilities



Source: Joint Pub 3-56.1, 14 November 1994, IV-1

Figure 2. Targeting Cycle Phases

Joint Pub 3-0 describes targeting as "The process of selecting targets and matching the appropriate response to them taking account of operational requirements and capabilities."[8] This straightforward definition is simple, but hardly complete. Targeting is certainly not the linear process these few words seem to indicate. Rather, it is a cyclical

process that operates in the context of friendly requirements and capabilities as well as the threats imposed by the adversary. The cycle begins with JFC-provided guidance and priorities, and continues with the identification of component requirements, the prioritization of these requirements, and the acquisition of targets or target sets. It continues with actual target attacks, and comes full circle with component and JFC assessments of the attacks which provide feedback within the cycle, adding guidance for future targeting plans. In essence, the continuous targeting cycle follows the flow of Figure 2; it moves from objectives and guidance, and proceeds through execution and combat assessment.[9]

Targeting matches inputs from intelligence and operations personnel to JFC guidance and objectives. Together, this input-guidance mix leads to the selection of specific targets and the identification of those forces necessary to achieve the desired objectives against those targets.

The JFC may establish and task an organization within his staff to accomplish broad targeting oversight functions or may delegate the responsibility to a subordinate commander, e.g., the JFACC. Typically, the JFC organizes a joint targeting coordination board (JTCB).[10] The JTCB operates at the discretion of the JFC; he defines its role. It may be an integrating center for the targeting effort or it may serve as a JFC-level review mechanism. Typically, it reviews target information, develops targeting guidance and priorities, and may prepare and refine joint target lists. The JTCB maintains a macro-level view of the AOR and ensures targeting nominations are consistent with the JFC's campaign plan. Likewise, it maintains a complete list of restricted targets, areas where

special operations forces are operating, and similar areas in need of deconfliction to avoid endangering current and future operations.

The JFC normally delegates the authority for execution planning, coordination, and deconfliction associated with joint air targeting to the JFACC. The JFACC, in turn, must possess a sufficient C^2 infrastructure in both personnel and equipment. Furthermore, targeting mechanisms dealing with detailed planning, weaponeering, and execution are required at the component level to facilitate this targeting process.

Synchronization, integration, deconfliction, allocation of forces, and weaponeering—matching weapons against target vulnerabilities—are essential targeting functions for the JFACC and his staff. Joint Pub 3-0 states, "All components are normally involved in targeting and should establish procedures and mechanisms to manage the targeting function."[11] Joint Pub 3-56.1 goes a step further, "targets scheduled for deliberate attack by component direct support air capabilities/forces should be included in the joint ATO, when appropriate, for deconfliction and coordination. . . . Therefore, components should provide the JFACC a description of their direct support plan through the liaison elements within the JAOC."[12] This allows for both coordination and deconfliction between each component and within the JFC staff and the JFACC C^2 infrastructure.

Two other specific targeting responsibilities outside the planning, coordinating, allocating, synchronizing, and deconfliction previously discussed are listed in joint doctrine as JFACC/JFC staff targeting responsibilities.[13] The first is to monitor execution and redirect joint air operations as required. The second instructs the JFACC or JFC staff to direct alert joint air capabilities/forces for prosecution of real-time targets in support of joint forces. Each has a direct bearing on sensor-to-shooter operations. Both occur in the

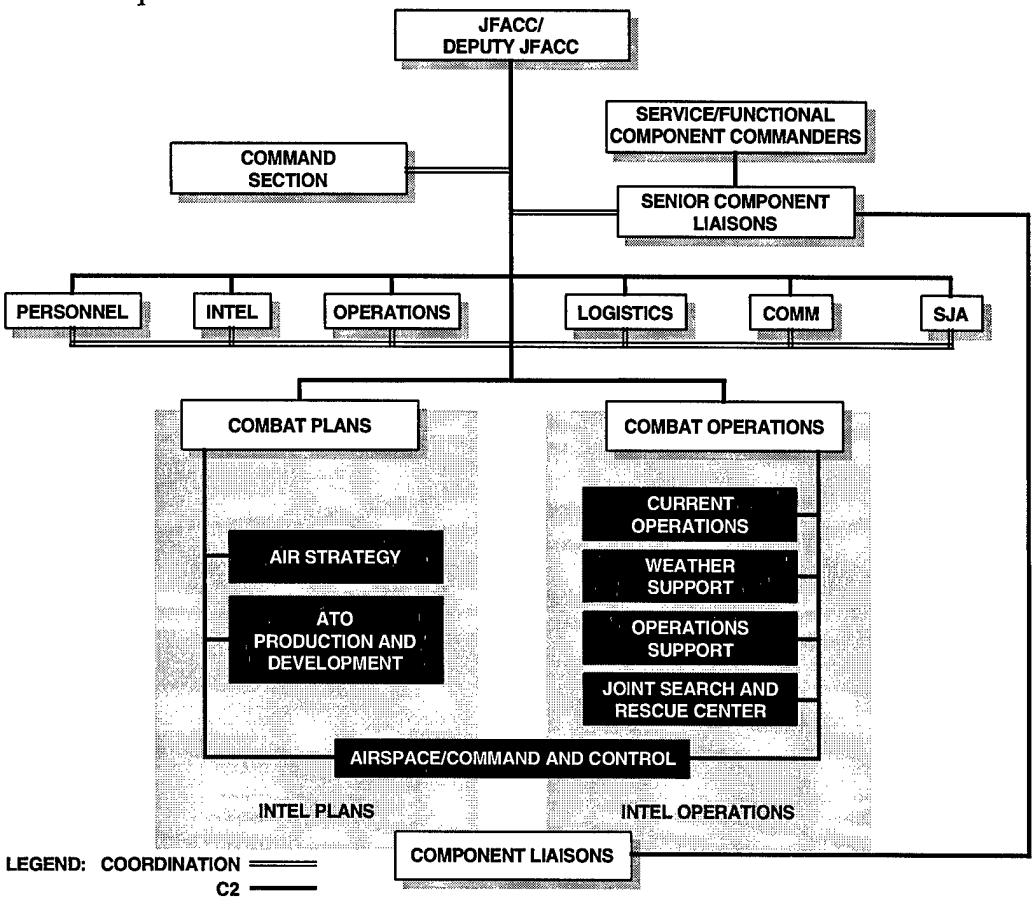
fifth targeting cycle phase, *execution planning/force execution*, and are the ultimate responsibility of the AOC's Combat Operations Division discussed in the next section.

The Joint Air Tasking Cycle

To effectively employ the available joint air assets, the JFACC uses a joint air tasking cycle. This repetitive process involves six phases to plan, coordinate, allocate, and task joint air missions. Phase 1, *JFC and component coordination*, produces JFC guidance. Phase 2, *target development*, results in the creation of a joint integrated prioritized target list (JIPTL). Phase 3, *weaponeering and allocation*, furnishes the MAAP. Phase 4, *ATO development*, generates the ATO and its associated special instructions (SPINS). Phase 5, *force execution*, leads to combat results. In turn, Phase 6, *combat assessment*, provides recommendations back to the coordination step in Phase 1.

This notional air tasking cycle accommodates changing tactical situations, revised JFC guidance, and support requests from other component commanders. Its phases are very much related to the targeting phases depicted in Figure 2, page 14.. In both cases the approach is the same, a systematic process matches available forces with targets to achieve operational objectives. The JFACC's air operations center provides the central C^2 structure for accomplishing the planning, developing, and coordinating of the air tasking cycle. Figure 3 shows a notional AOC. Two divisions form its core: Combat Plans and Combat Operations. Combat Plans is responsible for planning future air operations which includes the responsibility of drafting the joint air operations plan to support the JFC's theater campaign and building the daily ATO.[14] Execution of the daily ATO is carried out

by Combat Operations[15] which closely follows current air operations, "shifting missions from their scheduled times or targets and making other adjustments as the situation requires."[16]



Source: Joint Pub 3-56.1, 14 November 1994, II-6

Figure 3. Notional JFACC Organization (The Air Operations Center)

Both Combat Operations and Combat Plans are integral to the development and execution of the ATO. There are usually three ATOs in the air tasking cycle at any time: the current or execution-day ATO (today's plan), the ATO in production (tomorrow's plan), and the ATO in planning, (the following day's plan). This standard planning arrangement accordingly follows a three-day or 72-hour cycle. Combat Plans is responsible for planning *future* air operations. It normally develops the air operations

strategy and air apportionment recommendation, and produces the ATO in coordination with the Combat Intelligence Division. CID supports the ATO development process with information on the adversary's current and future force structure, capabilities, and intentions. Combat Operations is responsible for monitoring and executing *current* air operations. It normally assumes responsibility for the ATO when it is released.

The air tasking phase specifically critical to the Combat Operations Division is Phase 5, *force execution.* Real-Time flexibility is at a premium during this phase. The JFACC, through the Combat Operations Division of the AOC, directs the execution and deconflicts all forces made available by the JFC for the execution-day ATO. Combat Operations must be responsive to required changes during ATO execution. In-flight reports, initial battle damage assessment (BDA), significant weather changes, changing priorities, mission aborts, and the identification of time-sensitive targets[17] may prompt the redirection or retasking of forces before launch or once airborne. During ATO execution, Combat Operations serves as the central agency for revising the tasking of individual missions and force packages. It has the attendant charge to coordinate and deconflict those changes with the appropriate control agencies or components. Current joint doctrine states, "Ground or airborne command and control platform mission commanders may be delegated the authority from the JFACC to redirect sorties/missions made available to higher priority targets as necessary."[18]

Command, Control, Communications, Computers, and Intelligence (C^4I)

"The speed and pace of battle and the agility of forces is continually increasing. The commander with the greater ability to evaluate the battlefield and expose and exploit an

adversary's vulnerabilities will have the greater chance to prevail."[19] These truths were not penned by Sun Tzu or Clausewitz, but by the Chairman of the Joint Chiefs of Staff (CJCS) in his 1993 policy memorandum on command and control warfare. Their veracity will likely persist for quite some time. Today's TACS serves as the JFACC's vehicle for rapid, agile exposition and exploitation of enemy vulnerabilities.

The TACS is the organization, personnel, procedures, and equipment necessary to plan, direct, and control theater air operations and to coordinate air operations with other services and allied forces.[20] It is the JFACC's primary means of executing assigned duties. It provides the capability for centralized control while execution of operations is decentralized to the level that permits maximum responsiveness. The AOC, as the senior element of the TACS, has the capacity to display the current air and surface situation using data from all available sources. It maintains connectivity to various air and surface elements of the TACS. The AOC uses the Contingency Theater Automated Planning System (CTAPS) to produce and disseminate the ATO and manage its execution. Through the use of local and remote CTAPS terminals, the ground elements of the TACS have an instant computer interface capable of transferring time-sensitive operational and intelligence information. Similar information is passed from the AOC to air elements such as AWACS, ABCCC, and JSTARS via HF, VHF, UHF, SATCOM, TADIL, and other voice and data-links.

This chapter illustrates the air tasking process as it stands today. Though the process works well, it could work better with the integration of RTIC technology and the incorporation of an appropriate C^2 organizational architecture. The following chapter

shifts the focus from current airpower command and control to current and near-term sensor-to-shooter capability.

Notes

1. Joint Pub 5-0, *Doctrine for Planning Joint Operations*, 13 April 1995, I-2.
2. Joint Pub 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994, III-1.
3. AOR is defined in Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 23 March 1994, as "A defined area of land in which responsibility is specifically assigned to the commander of the area for the development and maintenance of installations, control of movement, and the conduct of tactical operations involving troops under the commander's control, along with parallel authority to exercise these functions." AOR is sometimes used synonymously with joint operations area (JOA), defined as "That portion of an area of conflict in which a joint force commander conducts military operations pursuant to an assigned mission and the administration incident to such military operations."
4. Joint Pub 3-56.1, III-2.
5. Samuel B. Griffith, ed. *Sun Tzu: The Art of War*. London: Oxford University Press, 1971, 84.
6. Carl von Clausewitz, *On War*. Edited and translated by Michael Howard and Peter Paret. Princeton: Princeton University Press, 1989, 595-596.
7. Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 23 March 1994, 63.
8. Joint Pub 3-0, *Doctrine for Joint Operations*, 1 February 1995, III-25.
9. Joint Pub 3-56.1, IV-1.
10. Joint Pub 3-0, III-26.
11. Ibid., III-26.
12. Joint Pub 3-56.1, IV-2-3.
13. Ibid., IV-3.
14. Ibid., II-7.
15. Ibid.
16. Ibid.
17. Time-sensitive targets are defined in Joint Pub 1-02 as "Those targets requiring immediate response because they pose (or will soon pose) a clear and present danger to friendly forces or are highly lucrative, fleeting targets of opportunity."
18. Joint Pub 3-56.1, IV-11.
19. Chairman of the Joint Chiefs of Staff Memorandum of Policy No. 30, Command and Control *Warfare*, 8 March 1993, 4.
20. Air Combat Command Instruction 13-AOC Volume 3, *Operational Procedures—Air Operations Center*, 1 June 1995, 16.

Chapter 3

Sensor-To-Shooter Capability

> *First, we must design our forces to collect all the information possible about potential adversaries. Second, we must shorten the time it takes the collected intelligence to reach the weapons system. Third, we must get the intelligence to the warfighter in a user-friendly format that allows the warfighter to employ weapons in a timely manner.*
>
> —C. R. Davis, Lt Col, USAF
> Airborne Reconnaissance: The Leveraging Tool For Our Future Strategy

Effective employment of air-to-surface airpower has always required an ability to identify and locate targets. This is nothing new. From spies in enemy territory, to pilot's eyes, to airborne electromagnetic sensors, to space-based satellite reconnaissance systems, putting bombs on target to achieve tactical, operational, or strategic effects has relied on the process of converting sensed data into useful information—information that is necessary for planning and conducting combat operations from the air. Reconnaissance is naturally a primary element of this process. The remainder of this process involves both the data-to-information conversion and the movement of appropriately formatted information from the reconnaissance platform to the attacking weapon system.

Also not new is the quest for more rapid transmission of the sensed targeting information from the sensor to the shooter. Colonel John Boyd's[1] discussion of an observation-orientation-decision-action cycle or OODA loop in many ways reflects similar thoughts expressed by Carl von Clausewitz in his classic *On War*. These same thoughts

were expressed by Lieutenant General Howell M. Estes III, Director for Operations, JCS J-3,

> Seeing the enemy, taking action before the enemy can react is what it's all about. . .that's called getting inside the enemy's decision loop. . . . Improving [our abilities on the battlefield] is going to be dependent on refining ways to get inside of this loop. An important way to do this is to gather the right imagery and to quickly get it to somebody that can do something with it. This is the challenge that we all face.[2]

To fully comprehend the advantages to be gained by direct sensor-to-shooter RTIC operations, one must understand the capabilities provided by current reconnaissance systems and the processing that transforms sensed data into useable information. With these fundamentals established, this chapter proceeds into current RTIC capabilities and concludes with a discussion of the continuing need for command and control.

Reconnaissance Systems

Throughout the history of warfare, commanders have sought to achieve a better understanding of the battlefield situation than that of their enemies. Friendly agents in enemy territory provided one means toward that end. Advantages gained through observations from some high elevation or overlooking promontory offered another. The better views offered by higher terrain were augmented by those from tethered observation balloons as early as 1792 when the French employed them against Austrian-Prussian forces at Valmy.[3] The airplane raised observation to new heights—literally and figuratively—during the Italian invasion of Libya in 1911 and soon after over the battlefields of World War 1.[4]

Many of the "reconnaissance systems" used during WW1 and before remain viable today; spies and eyes serve as prime examples. Today's intelligence agents, though

certainly more technologically sophisticated than their past counterparts, serve many of the same functions. It is the eyes of special operations forces (SOF) that are in many ways the same primary sensors used by the cavalry troops of the Napoleonic era. Numerous means of gathering enemy information, however, have advanced considerably since earlier days. Once inconceivable, systems such as national satellites, DSP satellites, DMSP satellites, U-2s, unmanned aerial vehicles (UAVs), RC-135 Rivet Joints, RC-135 Cobra Balls, E-8 JSTARS, and E-3A AWACS, which can provide instantaneous or NRT information, exist today.

There are a variety of ways reconnaissance systems may be categorized to aid a discussion of their capabilities. Systems once clearly delineated as national, theater, or tactical,[5] today have missions and produce information that no longer fit into a distinct category. The terms national, theater, and tactical no longer provide an adequate tool for clearly categorizing reconnaissance systems, just as the terms strategic and tactical rapidly blur when applied to modern aircraft capabilities. Grouping systems by type of information provided—electro-optical (EO), infrared (IR), synthetic aperture radar (SAR), moving target indication (MTI), COMINT, ELINT, HUMINT, IMINT, and SIGINT[6]—is straightforward. This arrangement, however, becomes cumbersome for illustrating the relationship between reconnaissance collection, data processing, information dissemination, and end-user application. A more useful classification scheme separates reconnaissance into space systems, aerial systems, and surface systems.

Space systems. Space systems have become an integral part of the national military forces providing support across the operational continuum and at all levels of war. Space systems provide information that allows commanders to assess the situation, develop

concepts of operations, and disseminate changes to their forces quickly.[7] National reconnaissance, surveillance, and targeting acquisition (RSTA) systems provide support to the National Command Authorities (NCA), and are also of great utility to combatant commanders. Information from national systems is provided to the JFC via Service component Tactical Exploitation of National Capabilities Program (TENCAP) systems.[8] Discussion of the *direct* role national space assets may have in the collection of reconnaissance or surveillance information is beyond the scope of this paper. Several non-national space systems, however, have a direct bearing on possible RTIC employment and are discussed below.

Defense Support Program (DSP) satellites provide one source of IR data to USSPACECOM's Tactical Event System (TES). This system is composed of three independent elements: Attack and Launch Early Reporting to Theater (ALERT), Joint Tactical Ground Station (JTAGS), and Tactical Detection and Reporting (TACDAR). Together, these elements ensure theater forces receive assured and timely warning of theater ballistic missile (TBM) launches.[9] The signature of the Iraqi Scud missiles proved to be the principal means of launch detection during Operation Desert Storm[10] DSP satellites successfully detected all eighty-eight Scud launches during that conflict. They also provided Space Command with observations that were then used to calculate the approximate location of the missile's launch site.[11]

The Defense Meteorological Support Program (DMSP) provides all important real-time and NRT weather information. Not only do these satellites allow the determination of areas and heights of cloud coverage, they also provide the raw data needed to resolve

often-crucial IR detection ranges for Forward Looking Infrared (FLIR), Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN), and other IR systems.

Aerial systems. Aerial systems are the primary source of RSTA for the JFC. All the Services possess and operate these systems, which have varying, but complementary, capabilities, limitations, and operating characteristics.[12]

The RC-135 Rivet Joint, and to a lesser degree the Navy's EP-3, carry a vast array of passive ELINT and SIGINT collectors to provide real-time threat warning, target cueing, and other classified functions via the Tactical Information Broadcast Service (TIBS) or via Tactical Receive Equipment and Related Applications (TRAP). Rivet Joint broadcasts this information to JSTARS and AWACS and, via satellite relay, to numerous users including the highest levels of the national command authority. A modified version of Rivet Joint, Cobra Ball, includes additional reconnaissance capabilities to include systems operating in the IR arena.

The E-8C JSTARS employs a steerable 25-foot antenna that incorporates side-looking airborne radar, SAR, and wide area surveillance/MTI radar modes to provide locations, numbers, vehicle differentiation, and direction of movement of forces and weapon systems.[13] It also has the ability to image surface-to-air missile sites, airfields, roadways, and bridges on a real-time basis.[14] JSTARS can process the data it obtains either on-board and data-link the processed information to the requester, or data-link the data directly to its deployable ground system where the processing is completed. In either case, the information—including SAR imagery—can be sent directly to the user in near real-time.[15] JSTARS employs Joint Tactical Information Distribution System (JTIDS), a Surveillance and Control Data Link (SCDL), or its on-board SATCOM system for

information updates, intelligence dissemination, and cross-cueing with AWACS, Rivet Joint, EP-3, ES-3, and other airborne and ground sites within and beyond line-of-sight.

E-3A AWACS combines a powerful airborne radar and numerous radio and data-link relays to merge air defense radar imagery into a coherent picture of the air battle. An important surveillance capability relevant to RTIC command and control is AWACS's ability to provide a real-time update of selected airborne weapon systems directly to, among other places, the AOC.

UAVs bring an additional reconnaissance capability to the theater. The CIA-operated Gnat 750-45 Lofty View and the Defense Airborne Reconnaissance Office (DARO) Tier II Predator reportedly carry a 450-500 pound payload consisting of a synthetic aperture radar with one foot resolution, three EO or IR sensors in a chin turret and a wideband satellite data-link antenna. The Gnat can fly extended distances and still stay on station 24 hours. The SAR, with its 150 degrees of azimuth and 40 degrees of elevation, can cover an 8,000-foot swath at 25,000-foot altitude.[16] The combination of long loiter times, a multiple sensor array, and a data-link capability allow it to transmit "real-time data in the form of moving video instead of the still pictures sent through UHF communications."[17] Other UAVs such as the Pioneer and Hunter are in the field. Still others, such as the Tier II+ Global Hawk and Tier III- DarkStar, may very soon add stealth, 24^{+}-hour loiter, MTI, SIGINT, wide-band data and communications relay, and other capabilities to those of the now-operational Lofty View and Predator.[18]

The U-2 uses an ASARS-2 (Advanced Synthetic Aperture Radar System) to digitally format radar images for monitoring target activity to more than 100 nautical miles from the aircraft's track. It also has the capability to collect IR imagery or employ the SYERS

(Senior Year Electro-optical Reconnaissance System) system for photographic imagery. Additionally, the U-2 contains extensive COMINT and ELINT collection suites. Though not all of the U-2's diverse products can be transmitted real-time, many can. Contingency Automated Reconnaissance System (CARS) sites receive data-linked collections which can be processed and forwarded to various users in near real-time.

Surface Systems. One of the principle missions of special operations forces (SOF) is special reconnaissance (SR). SR complements national and theater intelligence collection assets by obtaining specific, well-defined, and time-sensitive information. It may complement other collection methods where there are constraints of weather, terrain-masking, hostile countermeasures or other systems availability. SR is a human intelligence function that places US or US-controlled "eyes on target" in hostile, denied, or politically sensitive territory.[19]

The Significance of Intelligence Processing

Raw reconnaissance data, even when comprehensive and unquestionably accurate, are of little use to the warfighter. The data, in its most basic form, may be little more than a multitude of ones and zeros in the case of digitally transmitted satellite information. It may be a wonderfully clear photographic image of some location, but without additional, vital information such as the location of the photo, its orientation relative to north, and its time and date of origin, the image might be useless.

To be helpful this *data* must be processed into useable *information*. Imagery taken from an aerial or space-based sensor generally requires modifications in order to be useful. Several "hits" of IR data must be processed to differentiate between some ground

explosion and a ballistic missile launch. Still more data is needed to determine critical information such as missile launch point and expected impact area. ELINT data must be meshed with known PRF (pulse repetition frequency) information, and perhaps even geolocation information, to determine that an RF (radio frequency) emitter is a hostile surface-to-air missile target tracking radar, not a less threatening early warning radar or some communications relay site. Similar processing is needed to transform COMINT, HUMINT, and SIGINT data into useable information.

What drives the significance of intelligence processing in an RTIC environment are combat circumstances necessitating the redirection of planned sorties. An obvious first concern is the priority of a newly identified "pop-up" target. Only those assets planned, or *fragged*, against lower priority targets will be redirected against pop-up targets of higher priority.[20]

Many situations call for sortie retaskings. Some demand an immediate response by a large and diverse package of weapon systems. Others are less urgent or call for a much more limited diversion of aerial assets. Each of the four scenarios offered here are not meant to be inclusive nor detailed; rather they should illustrate merely a handful of plausible situations where effective retasking of airpower assets would be advantageous.

Scenario 1. Aircraft targeted against a high priority target abort their mission due to poor weather, lost tanker support, launch runway closure, etc. Other aircraft, originally planned against a lower priority target, are redirected against the first aircraft's higher priority target.

Scenario 2. A package enroute to a highly defended target loses its SEAD (suppression of enemy air defenses) support so it is retasked to a less well defended target.

Similarly, an ELINT collector's discovery of a previously unidentified threat in an area targeted by a non-SEAD supported, non-stealthy package forces a redirection of that package toward a less threatening environment.

Scenario 3. A pop-up TBM threat[21] is identified. As in the first scenario, this threat may be attacked by a shooter originally tasked to destroy a lower priority target.

Scenario 4. The CINC or JFC designates particular "fleeting targets" as high priority targets. An Internal Look '96 exercise input gave the following scenario: HUMINT sources in theater identified a truck convoy being loaded with naval mines at a previously suspected, but as yet untargeted, weapons storage area. The convoy departed the area for a nearby port facility to transfer the mines to awaiting vessels. The situation led to the retargeting of missions against both the convoy and the naval vessels.

Sortie retaskings in such scenarios or similar situations demand specialized intelligence processing. Threat briefings based on a planned ingress routing may become instantly worthless as a package is redirected. Target photos that were once vital, likewise lose their value as a mission is retargeted. An airborne crew cannot afford to return to base for new target materials. Rather, in an environment of dynamic "on the fly" retargeting, sufficient mission materials must find their way to the cockpit, both to ensure target destruction and to ensure crew survival. "Near" real-time imagery that is hours old may be sufficient in some retargeting scenarios, but does not suffice when minutes count as in scenarios 3 and 4. Target geolocation information that is 15 to 20 minutes old may allow a Scud TEL to evade attack when real-time information can help assure a kill.

RTIC would allow aircrews far more effective battlespace awareness and weapons employment in a retargeting situation. Not only would aircrew effectiveness be enhanced,

but RTIC could provide the JFACC with an observe-orient-decide-act cycle far more condensed than any before. To many, the capabilities espoused by RTIC—real-time imagery transfer to the cockpit, updated flight routing information, current threat intelligence, direct feed of targeting coordinates and weapons delivery parameters, and the like—seem plausible enough, but only in a not-too-*near* future. This future, however, is here, today, *right now.*

Information Transfer: The "Talon" Possibilities

Modern theater air warfare operations require the capability to process, correlate, and display national as well as organic near real-time and real-time information into the cockpit (RTIC) or directly to advanced weapons systems, and real-time information out of the cockpit (RTOC) to enhance combat execution and aircrew survival.[22]

The key to RTIC is getting the right information, to the right shooter, at the right time. This is the goal of the Air Force Tactical Exploitation of National Capabilities (AFTENCAP) Talon Shooter program. More specifically, Talon Shooter focuses on delivering enhanced real-time and NRT intelligence to and from aircraft cockpits, and to the weapons carried on aircraft. In effect, Talon Shooter "seeks to develop automated information update capabilities to bridge the gap from the aircrew pre-flight briefing to the full mission flight profile (ingress, over target, and egress).[23]

The potential mission execution benefits of RTIC enhancements are significant, including such things as: (1) threat avoidance updates; (2) imagery of targets; (3) navigational updates; (4) target location accuracy updates; (5) enroute and target area weather updates; (6) precision munitions and weapons computer updates; (7) retargeting

updates; and (8) passing immediate BDA from the shooter to rear C^2 elements to influence the current and next ATO cycle, and similar execution information which can increase the likelihood of mission success and aircrew survival.[24]

Talon Shooter has demonstrated the validity of the RTIC concept through Project Strike I, an Air Combat Command-Space Warfare Center cooperative effort conducted in July 1995. Strike I demonstrated significant opportunities in five areas: (1) the ability to tailor intelligence to support strike missions in progress; (2) the communications-dissemination architecture and connectivity to pass data to in-flight aircraft; (3) the interfaces and the actual on-board processing capability to display and apply the passed data; (4) the ability to conduct a successful target strike based on the use of the data provided; and (5) an AOC capability for the JFACC to tailor intelligence, including imagery and threat data, for direct dissemination to tactical platforms.[25]

The completion of Strike I objectives, exemplified by successes in each of the five areas above, moved the project from demonstration status into research, development, and acquisition (RD&A). Further research will be carried out through a Project Strike II. Acquisition is already underway for quick reaction capability (QRC) sets to allow for the modification of six B-1B Lancers to a configuration similar to that used for the B-1B portion of Strike I. RTIC is not an eccentric concept from some distant ethereal realm, but a demonstrated capability available today.

Though Strike I demonstrated the validity of employing real-time information into the cockpit, it did not directly address an overall concept of employing RTIC *operations*. The overriding concern for these operations is to provide the necessary mission information to aircrews that will allow weapons delivery on target *inside* the normal mission planning

cycle. The affected time frame ranges from a mission added to the execution-day ATO where target priority and TOT (time on target) considerations preclude routine mission planning to a retasked airborne mission already enroute to a target or flying combat alert. Necessary mission materials may vary with the specific weapon systems, however, routinely they would encompass ingress and egress routing, enroute and target area weather, enroute and target area threats, routing information (coordinates, charts, fuel considerations), weaponeering information (attack parameters), and targeting information (IR, radar, or photo imagery). "RTIC operations" should not bring instantaneous visions of theater-wide aerial *auftragstaktik* or mission-type orders. Though RTIC should improve battlespace awareness, it does not represent the fruition of any transparent battlefield concept. Perhaps in the *not so near* future, mission-type orders may be viable for air operations during a major regional contingency. Given today's technology, however, and the C^2 limitations of this technology, airpower remains best served by centralized control with decentralized execution rather than *de*centralized control with decentralized execution.

The Continuing Need for Command and Control

Air Force Manual 1-1, in its discussion of the tenets of aerospace power, describes centralized control as the "master tenet." It elaborates by stating, "Without centralized control, commanders cannot exploit the speed and flexibility of aerospace platforms to concentrate forces—whether in attack or defense—from diverse locations on decisive points, establish and enforce theater-wide priorities, execute synergistic campaigns, establish appropriate balances, or assure persistent attacks."[26] It further states that too

much or too little centralization has proved to be counterproductive. Too much centralization delays responsiveness; too little leads to dissipation of effort.[27] Clearly, RTIC furnishes an opportunity to shift the degree of centralization along this continuum. It allows a move toward greater *de*centralized control by providing the prospect of vastly increasing each aircrew's "information domain" to a degree where individual aircrews can make autonomous retasking decisions. More likely in the near term, RTIC shifts the degree of centralization in the opposite direction. It gives the JFACC, through his staff in the AOC, the tools to more effectively prosecute the JFC's objectives.

Longer term shifts toward decentralization, perhaps even radical changes to several long-held tenets of aerospace power, are likely, but only after potential problems are addressed and overcome. Three tenets of aerospace power—priority, synergy, and concentration—seem most at odds with moves toward decentralization. AFM 1-1 rightly points out that an air commander's operational priorities should flow from an informed dialogue with the combined or joint force commander. Furthermore, such an exchange will make it more likely that the JFC will set priorities based on a thorough understanding of the enemy's capabilities, vulnerabilities, and intent, an understanding that is essential lest scarce assets be inadvertently risked without having a significant impact on the outcome of the conflict.[28] RTIC-inspired decentralization, though offering improved tactical flexibility, may reduce the operational and strategic-level synergistic effects of more centralized control. This decentralization, even though individual aircrew battlespace awareness is at a peak, still may push airpower employment back toward the penny packet bane of previous conflicts.

Other more practical problems associated with moves toward decentralized control remain despite resolutions of priority, synergy, and concentration problems. Target deconfliction procedures could prove difficult to establish. Ensuring appropriate refueling availability and deconfliction would be no small task. Also, one cannot assume that the level of aircrew proficiency is uniformly high throughout an entire force. The lieutenant who may be exceptionally adroit at tactically employing his aircraft may be wholly unprepared to take on the decision making role essential in a decentralized control environment.

The control of airpower, in the future as well as in the past, whether more centralized or less, despite the level of technology used or the size of the forces involved, should provide the focus for airpower employment. Appropriate control remains essential to maximize airpower's flexibility and versatility, ensure its effective concentration, and properly apply airpower's tenets of priority, synergy, balance, and persistence.

Notes

1. John R. Boyd, "A Discourse on Winning and Losing," August 1987. A collection of unpublished briefings and essays. Air University Library, Document No. M-U 30352-16 no. 7791, 2.
2. "USIS 2000." Video presentation by the US Space Command Combined Intelligence Center, Peterson AFB, CO, April 1996.
3. Martin van Creveld, *Technology and War: From 2000 B.C. to the Present.* (New York: The Free Press, 1989), 184.
4. Ibid.
5. Dr. Taylor W. Lawrence, "Battlefield Awareness Program Overview" Briefing Slides, March 1996, 7.
6. Interview with Capt Daniel E. Johnson, Operations Officer, Combined Imagery Exploitation Facility, US Space Command. COMINT, ELINT, HUMINT, IMINT, and SIGINT are acronyms for communications intelligence, electronics intelligence, human intelligence, imagery intelligence, and signals intelligence.
7. Joint Pub 3-55, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations (RSTA)*, 14 April 1993, II-7.
8. Ibid., II-8.

Notes

9. Capt Shane Scott, "Parallel Reporting of Theater Ballistic Missiles," *SWC Space Tactics Bulletin* (Summer 95): 8.

10. Defense *Science Board Final Report on "Lessons Learned During Operations Desert Shield and Desert Storm."* (Secret), 8 January 1992, 65. Extracted information is unclassified.

11. Gulf War Air Power Survey Volume I Part II, *Command and Control Report*, March 1993, 247-248.

12. Joint Pub 3-55, II-3.

13. Edward H. Kolcum, "Joint-STARS E-8s Return to U.S.; 20-Aircraft Fleet Believed Assured," *Aviation Week & Space Technology* (11 March 1991): 20.

14. Craig Covault, "Joint-STARS Patrols Bosnia," *Aviation Week & Space Technology* (19 February 1996): 44.

15. Joint Pub 3-55, III-3.

16. "Tier 2 UAV Revealed" *Aviation Week & Space Technology* (7 February 1994): 23.

17. Stacey Evers, "Gnat-750 May Raise Profile of UAVs," *Aviation Week & Space Technology* (7 February 1994): 54-55.

18. Several sources discuss the capabilities of the Tier II+ and Tier III-, both of which are currently undergoing testing. David A. Fulghum, "Air Force Prepares New UAV Acquisitions, Operations," *Aviation Week & Space Technology* (27 November 1995): 52, and "Predator, DarkStar and other cult classics," *The Economist* (17 June 1995): 81, proved most valuable.

19. Joint Pub 3-05, *Doctrine for Joint Special Operations*, 28 October 1992, II-7.

20. The Chief of Combat Operations has the authority to retask aircraft based on mission priorities assigned by the JFACC based on CINC guidance. Interview with Lt Col James R. Brungess, Chief of Combat Operations, CENTCOM Exercise Internal Look '96, Camp Blanding, FL, 21 March 1996.

21. Gulf War Air Power Survey Volume II Part II, *Effectiveness Report*, March 1993, Chapter 6 details coalition efforts to eliminate the scud threat posed by Iraq against Saudi Arabia and Israel.

22. Capt Marta Bertoglio, Ed. "AFTENCAP Program Plan FY96," (FOUO), Space Warfare Center, Falcon AFB, CO, Information Cutoff: 20 August 1995, 4-19. Extracted information is unclassified.

23. Ibid., 4-17. Extracted information is unclassified.

24. Ibid., 4-18. Extracted information is unclassified.

25. Ibid. Extracted information is unclassified.

26. Air Force Manual 1-1, Volume II, *Basic Aerospace Doctrine of the United States Air Force*, March 1992, 113.

27. Ibid.

28. Ibid., 116.

Chapter 4

Enhancing JFACC Targeting Flexibility

> *[The long lead time in the Air Tasking Order development process] has sometimes been overstated. After the ATO was distributed follow-on coordination and revision were required, even with accurate and timely BDA. The issue is not whether the ATO was useful but rather how it can be improved. This experience points to the need for an interactive planning and information dissemination system that can meet the time lines imposed by modern warfare.*
>
> —James A. Winnefeld and Dana J. Johnson
> *Joint Air Operations*

The air tasking process in Operation Desert Storm met the time lines imposed on it by the Gulf War, but it may not have the flexibility necessary for today's wars or for those of the future. In its concluding chapter on command and control, the Gulf War Air Power Survey seems to concur with Winnefeld and Johnson when it states, "Because war is full of surprises, military leaders must try to create and maintain command and control systems (composed of personnel, procedures, and equipment) that can adapt to the unexpected by sensing, analyzing, and then solving the problems which the surprises endemic to war create."[1] The GWAPS goes on to say, "The Combat Operations Division provided real-time central control, coordination, and integration of ongoing air operations for the air commander."[2] "Real-Time" as used here, however, is a far cry from the type of "sensing, analyzing, and solving" or OODA cycle times that may be possible with today's sensors, processors, and information flow capabilities. In the search for lessons from the Gulf War,

authors such as Winnefeld and Johnson criticize the air tasking process, particularly the ATO cycle, for its "lack of flexibility."[3] A discussion of C^2 architecture involves more than a simple investigation regarding the sufficiency of the air tasking process in the Gulf War. The misconception that air planners require 48 hours to proceed from target identification to target neutralization does *not* invalidate the reality that the JFACC has less than optimum flexibility. In the Gulf War, JFACC servicing of targets was rapid; today, it can be quicker. JFACC control was flexible; today it should be "fluid."

Thinking Outside the ATO Paradigm

According to Navy Captain Lyle G. Bien in his article "From the Strike Cell," in the US Naval Institute's *Proceedings*:

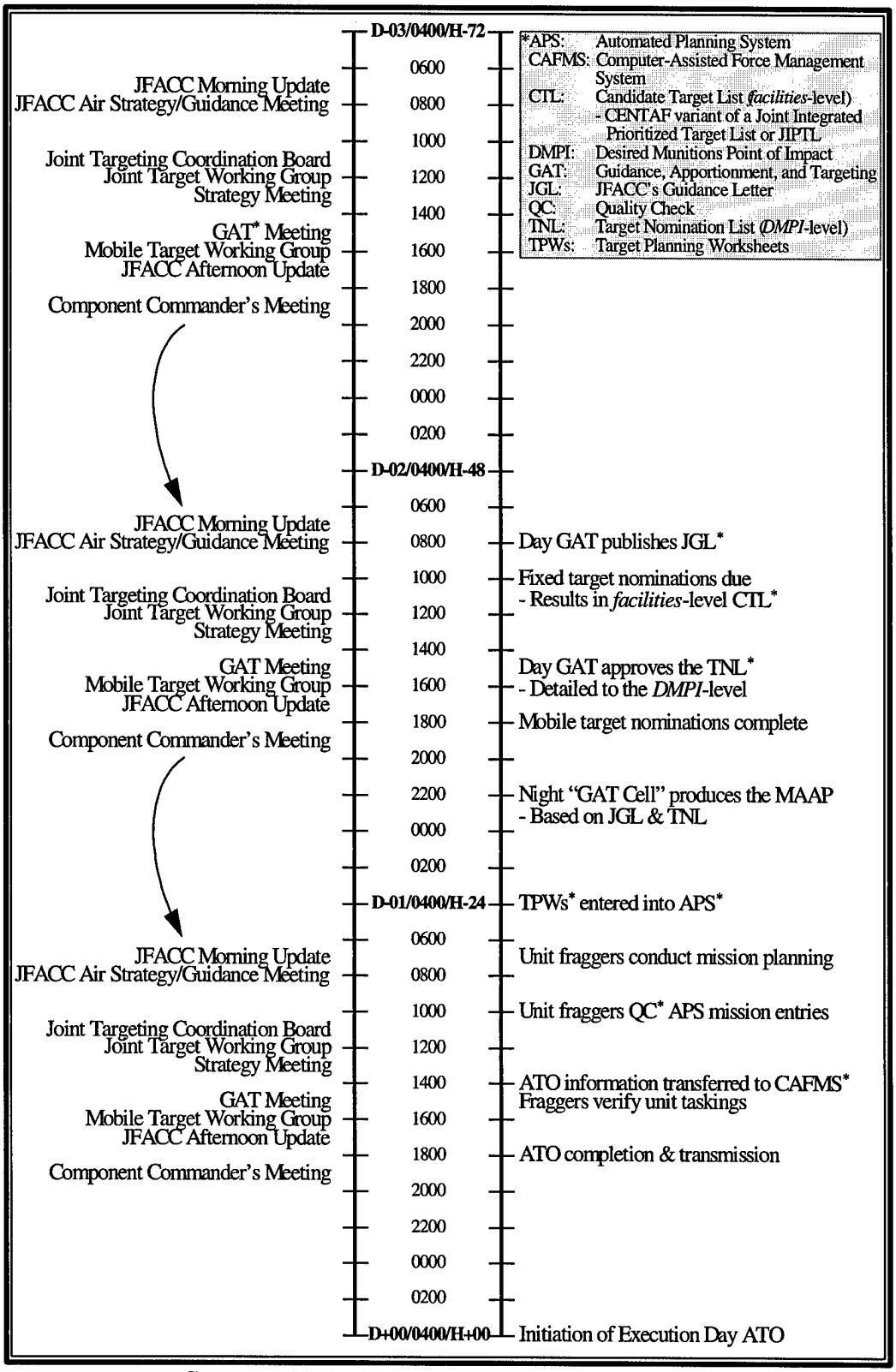
> The JFACC air tasking order. . .proved effective in managing the 3,000 daily sorties flown by Coalition air forces during Desert Storm, but the 48-hour ATO cycle did not permit rapid response to mobile targets. In a more dynamic war, only a reduced ATO cycle—which appears to be almost physically impossible—or a greater reliance on aircraft standing strip or airborne alert will be required.[4]

CAPT Bien expresses two opinions that seem prevalent regarding the ATO cycle: first, the timeline for ATO production is rigid, and second, mobile targeting—or time critical targeting (TCT)—is only accomplished through the use of ground or airborne alert assets. The so called "48-hour" air tasking process previously laid out in chapter two has worked well. It proved effective during Desert Shield and Desert Storm; it worked well for operations in Bosnia; and its usefulness has been born out in numerous exercises from the Central Command's Internal Look to Ulchi Focus Lens in Korea. Lt Gen Horner's command and control system during Desert Storm, a C^2 system based on this ATO process, not only worked well, but also showed it could adapt quickly to changes in the

operational situation.[5] Execution-day ATO interdiction and strategic attack missions were retargeted based on weather intelligence,[6] BDA,[7] and pop-up Scud notifications.[8] Similar retaskings took place for air refueling,[9] battlefield air interdiction (BAI),[10] and close air support (CAS)[11] missions. The fact that a nominal ATO process is roughly based on a 48-hour target nomination and planing cycle with a 24-hour execution period does not mean it *must* operate in some fixed, unalterable time frame. In Exercise Tandem Thrust '92 for example, the ATO cycle started just 11 hours prior to execution day and worked well for the numbers of participating forces involved. A far more serious misperception, however, involves the retasking of available assets within the execution-day ATO. CAPT Bein asserts the response to mobile targets appearing inside a given ATO planning cycle—or more broadly, time critical targets—will force a greater reliance on ground or airborne alert. He is mistaken. RTIC provides a distinct and far better alternative.

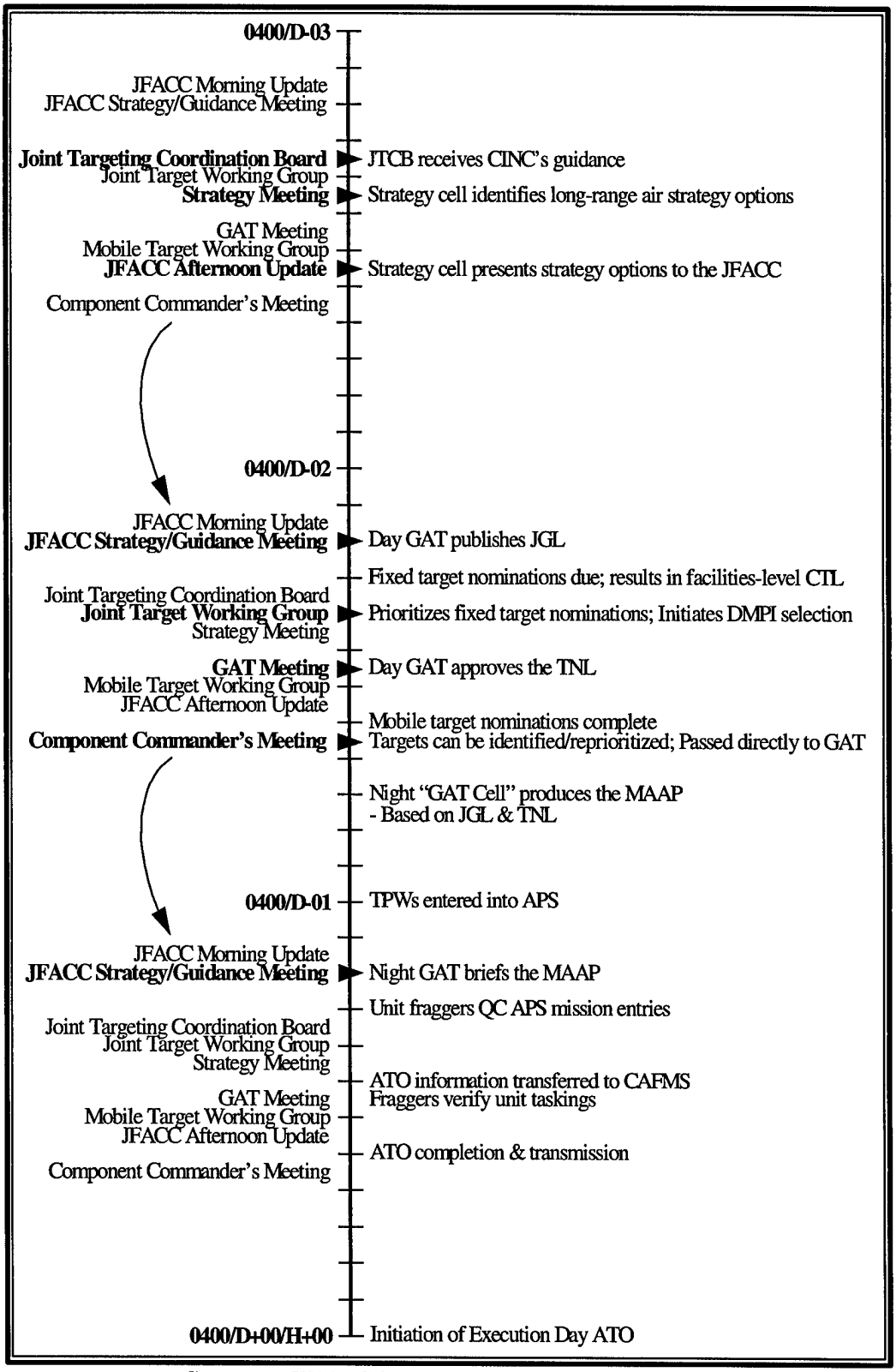
An examination of an ATO cycle's timeline should facilitate an understanding of the potential for RTIC applications. Figure 4 on page 41 presents a notional 48-hour ATO cycle. The center of the figure provides a time reference for both the recurring meetings listed on the left and targeting *events* on the right. Figure 5 on page 42 provides an expanded look into the process, delineating which group or meeting generates what product. Both figures indicate that fixed target nominations are due a full 40 hours prior to the start of the 24-hour execution-day ATO. (Note that "mobile targets" in these two figures refers to mobile enemy ground units.) Clearly, an attempt to set aside aircraft by scheduling ground or air alert missions to deal with high priority targets identified within this 40-hour window is less than ideal. Other options must be available.

The ATO paradigm refers to the concept that the only effective air tasking is air tasking done in advance. Notional air taskings as presented in Figures 4 and 5 ideally identify all targets to be attacked in a 24-hour execution period some 40^{+} hours in advance of that ATO's first launch. Current procedures exist to add targets identified inside this 40-hour window to this same ATO. Missions added to the ATO during the execution period that can still follow routine ground planning procedures still fit this paradigm.



Source: CENTCOM Exercise Internal Look '96

Figure 4.. Notional ATO Cycle



Source: CENTCOM Exercise Internal Look '96

Figure 5. Timeline to Produce an Execution-Day ATO

Thinking beyond this ATO paradigm is the responsibility of the Combat Operations Division in the AOC. The Combat Operations Division "supervises the execution of the ATO, adjusting and refining as necessary to accommodate battlefield dynamics."[12] The Chief of Combat Operations not only ensures that the air tasking done in advance by Combat Plans is carried out effectively, but also retasks missions on the published ATO as needed to thoroughly integrate the full scope of the air effort toward the attainment of theater objectives.[13] Fleet Marine Force Manual 3, *Command and Control*, appropriately summarizes the notion: "The measure of command and control effectiveness is simple: either our command and control works faster than the enemy's decision and execution cycle or the enemy will own our command and control."[14]

An Air Operations Center Rapid Response Cell

Current US airpower doctrine delegates the Combat Operations Division (COD) of the AOC the responsibility for monitoring and executing "current joint air operations." Decisions and actions that apply to the current ATO period are executed through the COD which normally assumes responsibility for the joint ATO as soon as it is released.[15]

Situations requiring retasking are identified to the Chief of Combat Operations (CCO) (senior operations duty officer, or SODO, outside USCENTAF and LANTAF). The CCO has prime responsibility for monitoring and directing the current air situation.[16] He performs these functions with the assistance of his offensive operations branch. Offensive Operations consists of a cadre experienced in battle management and well versed in doctrine and force application.[17] These personnel are augmented by offensive duty officers, specialists for each deployed weapon system and supporting function. Enlisted

duty technicians assist the processing of immediate air requests and perform routine flight following.

The CCO, through his offensive operations staff, first decides on the necessity for retasking a mission on the published ATO based on the situation (such as those characterized by the scenarios on pages 29 and 30 in Chapter 3), target priority, and rapidity of response needed. With that judgment made, he determines suitable shooter availability. Is there a shooter in an appropriate phase of flight for retasking? Approaching the IP (initial point for beginning an attack) is too late. Does the shooter have an appropriate weapons load for the given target? Does the shooter have the necessary fuel to get to the target and return to base (RTB) or post-strike refuel? If refueling is required, are appropriate tanker assets available? Given the aircraft and its weapons load, will the enroute and target area weather permit mission accomplishment?

With this information, he chooses one of four actions. **Action 1**: Retask no one. The target priority is insufficient to warrant retasking on the current ATO or appropriate shooters are unavailable for a sufficiently prompt response. **Action 2**: Retask a non-airborne, non-alert mission. The target priority is sufficient to warrant retasking a mission on the current ATO, however, the situation is acceptably stable to allow some mission planning by crews prior to takeoff. **Action 3**: Task an airborne or ground alert mission. **Action 4**: Retask an airborne mission of lower priority or retask an available higher priority mission while retasking a lower priority mission(s) to cover the retasked higher priority mission.[18]

Each of these four actions can occur, have occurred, and will continue to occur without the advantages of RTIC. Mission success, however, specifically relating to

actions 3 and 4 can be in doubt even when conditions are heavily in the crews' favor. Concerning *The Great Scud Chase* during Desert Storm, GWAPS recorded, "It was soon clear that only aircraft flying on station over the launch sites could attack the mobile launch platforms before they escaped. . . . But even then they could have a difficult time. On 9 February the Current Ops Log reported: 'Scud launch-Israel. Two F-15Es were on station and saw the launch but were unable to find the launcher. Two F-15Es on target immediately-two additional F-15Es closed within five minutes. No luck.'"[19] Along with information, RTIC brings an increased probability for mission success.

Once again, the overriding concern for RTIC, and consequently for an RTIC cell, is to provide the necessary mission information—routing information, enroute and target area weather, enroute and target area threats, weaponeering information, and targeting information—to aircrews allowing weapons delivery on target inside the normal mission planning cycle. Action 1, no retasking, obviates the need for RTIC. Action 2, though it requires no real-time information into the *cockpit*, can be supported by the unity of action provided by an integral RTIC cell. Tasking an alert mission or retasking an enroute mission, as called for in actions 3 and 4, truly put the concept of an RTIC cell to the test.

A prime consideration for an RTIC cell is its composition. The driver behind its organization is the information it must provide to the aircrews of a retasked mission. This calls for five elements in the cell: a mission coordinator (MC), aircraft specific mission planners (MP), a photo interpreter (PI), an intelligence threats representative (IN), and a weather expert (WX).

Currently, the responsibility for retasking missions falls to the CCO. This should continue as mission retaskings split into two branches, retasked missions requiring RTIC

and retasked missions that do not. The CCO's "second hat" as RTIC MC follows the airpower tenet of *centralized control.* The creation of an RTIC cell does not obligate the division of execution-day ATO mission control currently embodied in the CCO. The MC's role in an RTIC cell would be very much akin to the CCO's present duties of monitoring and directing the current air situation. Specifically, he would determine the missions to be retargeted, and ensure the appropriate information is channeled to the crew. MPs, experts in their particular weapon system, take on the responsibility of preparing rerouting and weapon-specific attack profile information. The PI's role, in coordination with the MPs, is to select the proper imagery from the appropriate source(s) for transmission to the shooter. The MP-PI team ensures that routing information, if needed, is passed on the correct scale charts, that radar imagery is omitted if not needed, that photo imagery is presented from the best possible perspectives and scales. Essentially the MP-PI team makes certain only a proper amount of best-possible, weapon-specific information is delivered to the crew. IN supports the MPs by integrating real-time and NRT threat information into the retargeting process to assure maximum safety for the crews. WX provides input to the MC regarding the viability of retargeting a mission based on enroute and target area weather. WX also feeds this information to the MP-PI team to ensure viable routing and to ensure laser, IR contrast, and other weather-based considerations are factored into attack options.

A second essential consideration is the location of the RTIC cell. The current configuration of the combat operations division of the AOC furnishes a made-to-order environment for the operations of an RTIC cell. The CCO position can take on the parallel responsibilities of the RTIC MC. MP, PI, IN, and WX expertise is already

resident in the COD though additional personnel may be required to augment the RTIC cell depending on the level or effort it is expected to assume. Naturally the same concerns over in-theater placement of the AOC would apply to an RTIC cell adjunct of the COD. The pros and cons of AOC locale and possible alternatives to in-theater placement are outside the scope of this paper. Nonetheless, discussions on either side of this debate apply equally as well to the placement of an RTIC cell as they do to the location of the AOC.

With an appropriately staffed air operations center RTIC cell in a theater hosting RTIC-capable aircraft, how is airpower targeting affected? Is there or should there be an impact on targeting at all? Targeting takes on two definitions in Joint Pub 1-02. First, it is simply a *process* for selecting targets and matching the appropriate response to them, taking into account operational requirements and capabilities.[20] Second, it is more meticulously defined as the *analysis* of enemy situations—relative to the commander's mission, objectives, and capabilities at the commander's disposal—to identify and nominate specific vulnerabilities that, if exploited, will accomplish the commander's purpose by delaying, disrupting, disabling, or destroying enemy forces or other resources critical to the enemy.[21] A third definition deals with targeting's impact on "the mission cycle." Targeting is discussed as "a decision making process used by commanders to employ forces. . .there are six general mission steps: detection, location, identification, decision, execution, and assessment."[22]

RTIC introduces significant change to targeting as presented in the each of these definitions. *Matching an appropriate response to a selected target* in an RTIC environment, as described in the first targeting definition, embraces a level of airpower

flexibility and versatility considerably beyond that described in Air Force Manual 1-1.[23] In light of the rapid pace of the modern battlefield, and especially in light of mobile surface-to-air and TBM threats, RTIC allows the JFACC, through his staff and TACS, to retask execution-day ATO missions far more effectively than previously possible. In an RTIC environment, a retasked crew does not depart blindly from a well planned mission toward a set of coordinates associated with some inadequately described target. Instead, they maneuver their aircraft from one well planned mission to another, and they do so with impressive battlespace awareness.

RTIC has a lesser impact on targeting from the second definition's perspective. *Analysis of the enemy situations* is mostly unaffected, however, *identifying specific vulnerabilities* can change. In situations where the US or its coalition partners do not have a surplus of air assets as arguably was the case during Desert Storm, RTIC may allow for the creation of a dual-focused target priority system and reduce, even obviate, the need for targeting via ground or airborne alert assets. One target priority *focus* would replicate today's JIPTL. The other *focus* would rank the priorities of additional time critical targets. This second focus would expand the overall list of targets based on increased vulnerabilities associated with RTIC capabilities. Together, the integration of these two focuses would provide the CCO invaluable guidance on retasking missions.

A look at the impact of RTIC on targeting's *mission cycle*—detection, location, identification, decision, execution, and assessment—reinforces the overriding near-term value of the concept. Of the six steps in this cycle, RTIC most directly addresses two: decision and execution. RTIC provides vastly superior flexibility for the JFACC decision making process during the actual course of battle. Also, it equips the JFACC with a truly

remarkable method of executing those decisions. Joint Pub 1-02 defines operational art as "The employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles. Operational art translates the joint force commander's strategy into operational design, and, ultimately, tactical action, by integrating the key activities at all levels of war."[24] To highlight RTIC's impact on operational art, the definition should be written as, the *employment of military forces* to attain strategic and/or operational objectives through the design, *organization, integration, and conduct* of strategies, campaigns, *major operations, and battles.* Operational art *translates* the joint force commander's strategy into operational design, *and, ultimately, tactical action*, by *integrating* the *key activities* at all levels of war.

Sensor-to-*Processor*-to-Shooter

The principal question involved in examining the conversion and transfer of sensed data to shooter information is "What information is required by the shooter?" The first piece of information an aircrew needs is the fact that their mission is being redirected. Secondly, the crew needs a variety of mission information: routing information, enroute and target area weather, enroute and target area threats, targeting information, and weaponeering information. Each of these information needs involves some link between a sensing or reconnaissance system on one end and the tasked weapons system on the other.

The RTIC cell mission commander does not arbitrarily redirect an execution-day ATO mission. Mission retasking decisions are based on a variety of factors: mission aborts, previous mission BDA reports, the detection of a time critical target, and

appropriate shooter availability.[25] Each of these factors involves sensors of one kind or another. Mission aborts may be "sensed" by wing weather personnel who report takeoff field conditions as WOXOF (weather of 0 foot ceilings, obscured, 0 foot visibility, and fog) or they may be relayed by AWACS as an entire package of bombers, escorts, and SEAD assets aborts due to the loss of tanker support. Near real-time BDA reported by an aircrew just experiencing PGM "no-guides" against a high priority target was "sensed" by the aircraft's on-board delivery system. DSP-derived information on the location of a Scud launch may impact retargeting decisions. It also may not if appropriately located, appropriately armed shooters are unavailable.

The sensor-to-processor-to-shooter path may be quite clear in situations involving weather reports and shooter BDA; it may be less discernible for other cases. What is important is the path's impact on possible RTIC operations.

Sensor-to-processor-to-shooter paths may differ for time critical versus non-time critical targeting. Each retasked mission will likely require different and often unique information; the applicable sensors may not be the same; and required processing may differ. Nonetheless, the path's impact on possible RTIC operations remains critical.

Diverse yet notably important sensor-to-processor-to-shooter paths are exemplified by the following sensor-processor-shooter-RTIC scenario involving high priority TBM detection and targeting. Geosynchronous DSP satellites identify and downlink a host of IR data. Within moments, the data is received and separate IR "hits" are correlated by the equipment and personnel in the 11th Space Warning Squadron at Falcon AFB, CO. Several bits of data indicate the possibility of a TBM launch. An aural warning goes out to operations centers in the affected theater simultaneously with the threat warning sent

out via TIBS and TRAP.[26] AWACS-provided TIBS information displays RTIC-capable shooters enroute to targets in an area near the TIBS-provided coordinates of the Scud launch site. The Chief of Combat Operations identifies shooters who are sufficiently far from their targets to negate the possibility they have begun their pre-planned attack. He verifies their weapons load is compatible for the time critical targeting of a Scud or its TEL, and engages the RTIC cell to ensure the threat situation between these shooters and the Scud launch site is acceptable, and to provide an initial vector to the now retasked shooters. As previously arranged, Cobra Ball and JSTARS aircraft, upon receipt of the same TIBS Scud launch information, reorient their sensors to the launch area. Cobra Ball's IR and SIGINT sensors refine the elliptical area bounding the possible TEL location. This information is used by Joint-Stars to locate then track the TEL while simultaneously data-linking updated TEL coordinates directly to the approaching shooters' weapon systems. Steering cues from the JSTARS link tie in to the shooters' IR targeting systems allowing the aircrews to locate, identify, and destroy the TEL and other scuds readying to launch.

Certain sensor-to-processor-to-shooter paths require human intensive processing; others do not. A brief examination of the mission information needs of a redirected aircrew—routing, weather, threats, targeting, and weaponeering information—highlights areas where human interaction and planning is still critical and underscores areas ripe for automation.

In an RTIC environment, route determination for a retasked mission is not heavily dependent on persons other than the retasked crew. Certainly the aircrew must know the location of the target and, in some cases, the location of the initial point (IP) from which

the attack will begin, but meticulous preplanning of a route to the target or IP could be unnecessary when real-time and NRT weather and threat information is available in the cockpit.

Several reconnaissance systems collect threat information that may impact a retasked mission's route of flight. Regardless of the collection system, ELINT and SIGINT processing occur in NRT[27]. Processed, threat-specific information can be loaded automatically into TIBS/TRAP for immediate dissemination throughout the theater. This off-board, broadcast information can be transmitted directly to enroute aircraft via tactical digital information links (TADILs). On-board avionics such as the Talon Shooter project's real-time symmetric multi-processor (RTSMP)—a downsized supercomputer designed for inflight use—offer further processing of off-board and on-board information to provide crew-selectable displays of threat information. Aircrews may elect to disregard acquisition systems and display only threats that are within lethal range of the aircraft or route of flight. They may color-"tag" threats to indicate when the information was last updated. The RTSMP can factor aircraft altitude, course, and speed into the determination of threats' lethal radii, and display the threats with their associated "lethality rings" to allow the aircrew to select appropriate routing.[28] Regardless of the information's display, the sensor-to-processor-to-shooter path for threat information is both direct and short.

A similar direct, short path applies to theater weather. This information is available in real-time and NRT depending on the sensor used and its location relative to the theater, and could be provided to enroute aircrew as part of TIBS/TRAP broadcast information. Like threat information, knowledge of enroute weather may be vital to the determination

of a redirected mission's route of flight. Unlike threat information that shooter aircrews can receive via TIBS/TRAP then display in a cockpit-selectable fashion, specific weather-based weaponeering information such as target detection range or laser attenuation specifics requires extensive, less rapid processing.

In general, weaponeering and targeting involve a degree of expert human interaction that, at present, exceeds the capabilities of automated systems. Determining the appropriate types and numbers of munitions or the necessary aimpoint that must be hit to achieve a desired effect on a specific target remains as much an art as a science. Likewise, the integration of targeting with intelligence and operations information on force posture, capabilities, weapons effects, objectives, rules of engagement (ROE), and doctrine requires more than automated systems can provide.

Though apparently straightforward, the seemingly mundane task of obtaining and transmitting appropriate target imagery to a redirected shooter illustrates the need for human interaction. Many if not most imagery products not already part of some archive or database require significant processing to convert raw data into aircrew-useable images and may be available only on an NRT basis. Even imagery products immediately at hand in an AOC require processing before they are readily useable in the cockpit. Systems such as 5D (Demand Driven Direct Digital Dissemination), Power Scene, IDEX (Imagery Data Exploitation), and DIEPS (Digital Imagery Exploitation Production System) either link the AOC to various databases and archives to bring needed imagery in, or allow the manipulation of available imagery to provide a set of images specifically oriented to both the attack heading and run-in altitude of the diverted attacker.[29] These systems allow a mission planner-photo interpreter team to provide suitable imagery—optical, SAR, or

IR—tailored to the weapon system's crew. This may include a wide-area image to provide initial target area recognition cues, a narrower field of view image to refine the area perspective to a specific target view, and an image of the specific desired munitions point of impact or DMPI. This imagery also may be processed to include views of the target appropriately oriented to a given attack profile. This processing is not only available, but in many instances is extremely important. In other instances, time is the more critical element, and less-processed, more rapid information is highly preferable over well-processed, slower information.

Greater automation of information processing holds the promise for more rapid decision cycles. Automated information processing, however, does not assure automated decision making. Even in an environment of completely direct sensor-to-shooter pathways, an RTIC cell will be necessary for effective sensor-to-shooter operations until expert systems can provide more fully developed mission information and can be more fundamentally integrated into the decision making process.

Direct Sensor-to-Shooter

Currently, little if any data goes directly from sensor to shooter. With several reconnaissance systems, however, sufficient on-board processing is available to allow the transfer of information, not data, directly to expectant shooters. Sufficient communications bandwidth, a severe limitation in the past, remains a concern, but is ameliorated in a world of HF, VHF, UHF, SHF, SATCOM links, K_u band data links, joint tactical information distribution systems (JTIDS), tactical digital information links

(TADILs), tactical data information exchange systems (TADIXs), tactical receive equipment (TRE), and multi-mission advanced tactical terminals (MATT).

The information sent directly from the sensor to a shooter can be nearly as diverse as the communication paths over which it is sent. HUMINT definitely refers to a collection system with on-board processing and is perhaps the simplest application of the direct sensor-to-shooter concept. Real-Time communications from special forces personnel can provide excellent, and sometimes otherwise unobtainable, information. ELINT and SIGINT collections from national sensors can provide NRT threat information that in essence travels direct from the sensor to appropriately equipped shooters.[30] Additionally, IMINT in the form of optical, SAR, or IR imagery annotated with latitude and longitude of the target can be linked directly from either U-2 or Predator aircraft. This imagery may be supplemented with other information such as a mobile target's coordinates, heading, and speed. This flow of diverse information into the cockpit, whether from sensor-to-shooter or sensor-to-processor-to-shooter, is achievable today with radios such as the multi-mission advanced tactical terminal (MATT) offering data flow rates approaching 20 Kbps on each of its 4 channels, and on-board processors like the real-time symmetric multi-processor (RTSMP) performing 20 million instructions per second throughout the dynamic flight environment of the F-15E. High volume information flow, however, in only an enabler for RTIC; it is a necessary, but not sufficient condition for the overall RTIC concept.

Integrated Flexibility

Real-Time information into the cockpit complements on-board sensors to increase battlespace awareness; it does not replace those sensors.[31] Similarly, RTIC supports the ATO process; it does not replace it. It does not provide a panacea to cover for imperfect intelligence, an incomplete command and control systems, or insufficient forces. It does, however, bolster a key tenet of aerospace power. It provides tremendous *flexibility* to the JFACC on the actual employment of forces. RTIC may even be called, with accuracy, a force multiplier.

Having an RTIC cell does not eliminate the need for the Airborne Command Element (ACE) aboard AWACS which can, "when necessary, assume the command authority of a Tactical Air Control Center over aircraft flying combat air patrol with an AWACS or over airborne strike formations preparing for an attack mission."[32] It does not replace the Battlefield Coordination Element (BCE) aboard ABCCC. Rather, the abilities of an RTIC cell fill a C^2 niche in the air tasking process in a manner currently unavailable to the ACE, BCE, or Chief of Combat Operations. An RTIC cell provides an additional dimension of command and control that allows for more effective decision making and improved execution during the execution-day targeting cycle.

As with the ATO that at some point must prohibit further changes, the flexibility offered by RTIC has limitations as well. Retasking a mission on its IP to target run is just as foolish with RTIC as without. Yet along a continuum during the execution-day ATO, from a point where target priority and TOT considerations preclude routine mission planning to a package nearing its IP to target run, real-time information into the cockpit

offers an OODA cycle unprecedented in aerial warfare. It offers today's JFACC a tool to more effectively employ American airpower and American airmen in combat.

Notes

1. Gulf War Air Power Survey Volume I Part II, *Command and Control Report*, March 1993, 137.
2. Ibid., 145.
3. James A. Winnefeld and Dana J. Johnson, *Joint Air Operations.* (Annapolis: Naval Institute Press, 1993), 110.
4. CAPT Lyle G. Bien, "From the Strike Cell," *Proceedings* (June 1991): 59.
5. Gulf War Air Power Survey Volume III Part II, *Support Report*, March 1993, 95.
6. Ibid., 94.
7. Gulf War Air Power Survey Volume V Part II, *Chronology*, March 1993, 234.
8. Gulf War Air Power Survey Volume I Part II, 252.
9. Gulf War Air Power Survey Volume II Part I, *Operations Report*, March 1993, 204.
10. Gulf War Air Power Survey Volume V Part II, 253.
11. Ibid.
12. Air Combat Command Instruction 13-AOC Volume 3, *Operational Procedures—Air Operations Center*, 1 June 1995, 32.
13. Ibid.
14. Joint Pub 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support*, 1 December 1995, II-1.
15. Joint Pub 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994, C-2.
16. Air Combat Command Instruction 13-AOC Volume 3 states on page 32 "The SODO [CCO for USCENTAF] has prime responsibility for monitoring the current air situation and advising the CCO [DCO for USCENTAF] of dynamic mission requirements and resource status. . . .When a requirement is of an immediate nature, the SODO summarizes the current air situation for the CCO, who approves/disapproves adjustments to the published ATO." During USCENTCOM Exercise Internal Look '96, Lt Col Brungess, as CCO, had prime responsibility for both monitoring *and directing* adjustments to the published ATO.
17. Ibid.
18. Certainly this brings out concerns regarding possible "ripple effects," however such contingencies were exercised during Internal Look '96.
19. Gulf War Air Power Survey Volume II Part I, 188.
20. Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 23 March 1994, 380.
21. Ibid.
22. Ibid., 245.
23. Air Force Manual 1-1, Volume II, *Basic Aerospace Doctrine of the United States Air Force*, March 1992, 115-116.

Notes

24. Joint Pub 1-02, 274.

25. Interview with Lt Col James R. Brungess, Chief of Combat Operations, CENTCOM Exercise Internal Look '96, Camp Blanding, FL, 21 March 1996.

26. Interview with Lt Col Darrell Herriges and Maj Christopher H. Frasier, 11th Space Warning Squadron, Falcon AFB, CO, 4 January 1996.

27. Interview with Mr. Ronald Cole, National Security Agency Liaison to US Space Command, Peterson AFB, CO, 3 April 1996.

28. Interview with Capt Geoffrey H. Hills, Chief, Space/Weapon Systems Integration, Space Warfare Center, Falcon AFB, CO, 5 April 1996.

29. Interview with Capt Daniel E. Johnson, Combined Imagery Exploitation Facility (CIEF) Operations Officer, Warrant Officer Michael E. Waliohn, Canadian Forces CIEF NCOIC, and TSgt David A Grubbs, CIEF Team B Exploitation NCOIC, Combined Intelligence Center, Peterson AFB, CO, 4-5 April 1996.

30. Larry Arkfeld, "Combat Integration Capability (CIC) Communications Plan: Revision A," Unpublished paper prepared for SWC/DOZC, 6 October 1995, 3.

31. Major Zigfried J. Dahl, "The Talon Shooter RTIC Road Show" Briefing Slides, Undated, 31.

32. Gulf War Air Power Survey Volume I Part II, 98.

Chapter 5

A Look To The Future

If a man does not give thought to problems which are still distant, he will be worried by them when they come nearer.

—Confucius
The Sayings of Confucius

The joint campaign should fully exploit the information differential, that is, the superior access to and ability to effectively employ information on the strategic, operational and tactical situation which advanced US technologies provide our forces.

—Joint Pub 1
Joint Warfare of the Armed Forces of the United States

Referring to an Air Combat Command study on the air campaign in the Gulf War conducted by SDS International, Colonel Bruce Gillette, Chief of the Air Force Theater Air Defense Requirements Division, said "The study looks at what can be done that will give the best payoff [in destroying mobile theater ballistic missile launchers]. Should we improve the sensors, the shooters, or the command-and-control systems?"[1] The answer should be yes. Yes, we should improve the sensors. Yes, we should improve the shooters. Yes, we should improve the C^2 systems. These improvements should not only address the threat posed by TBM or the potential offered for theater missile defense (TMD), they also should address the integration of all three—sensors, shooters, and C^2 systems.

The RTIC cell construct laid out in this paper offers increased targeting flexibility to the modern JFACC, but it is only an incremental step down the path toward minimized decision cycles and maximized targeting effectiveness. Integrated sensor, shooter, and C^2 improvements will allow the US military to further its journey down the path toward maximum airpower effectiveness.

Sensors. A handful of today's sensors have the ability to directly link information to a shooter. Much of this information is threat related; some is data related; little is imagery related. An ability to broadcast real-time imagery of a stationary or moving target along with specific geolocation and, if needed, moving target information, from a wider variety of sensors to individual shooters is plausible. IR sensing capabilities added to the entire fleet of RC-135s may add a tremendous counter-TBM capability. This improvement, refined DSP data processing, and additional IR capabilities and sensor range expansions for JSTARS offers added opportunities to precisely locate TBM units.

Various other sensors are on the horizon. RF/seismic sensors capable of deriving 3-D conformations of underground structures offer an ability to locate, identify, and target underground facilities.[2] "Relaxed-optical-tolerance imaging"[3] presents an opportunity for producing fine resolution, space-based imaging at greatly reduced costs by overcoming reduced hardware tolerances with post-detection processing, i.e., overcoming low-cost less-capable hardware with improved computer software. Micro-electro-mechanical systems, bistatic SAR systems, ultraspectral optics, quantum well infrared photodectors, and other obscure technologies appear to offer the promise of continuing improvement in sensor systems and their component technologies.[4] More importantly, the prospect for

sensor correlation and fusion in the context of a "system of systems" architecture is increasingly bright.

Shooters. Two areas offer the greatest potential for future improvement to the CAF (combat air forces) regarding RTIC: communications, and direct weapon systems links. Improved communications capabilities for both voice and data information flows are a must. The idea that there is a single aircraft sent into combat without the threat information capabilities offered by TADIL-J or its equivalent seems reprehensible. As RTIC capabilities improve, RTIC-capable aircraft should include single-seat as well as multi-place shooters. This may prove viable once the integration of off-board information can occur automatically with an input feeding directly into the shooters' navigation and targeting systems. A third area of expanding future capabilities does not concern RTIC, but real-time information out of the cockpit. RTOC adds another dimension to the targeting flexibility offered by RTIC through improved and more rapid BDA. Another clear area regarding the future of RTIC is the expansion of its use from force application via deep interdiction and strategic attack missions to force application in the CAS and counter-air missions. RTIC should also have a place in force enhancement missions such as airlift and air refueling.

C^2 Systems. The future may hold the promise for airpower employment via the command and control procedures of an *auftragstaktik* system where mission-type orders are employed in a *de*centralized control-decentralized execution environment. This will be truly effective only when the promise of near-complete battlespace awareness becomes a reality. Until that time, real RTIC C^2 advances likely will come from ever-widening communications "pipes" allowing exponential increases in sensor-to-shooter information

flows and sensor cross-cueing capabilities. Steady improvements should also occur as the RTIC *concept* goes through the day-to-day learning process of becoming RTIC *operational reality.*

Systems are required that can support decisions by bringing to bear all relevant information, including the fusion and presentation of current and historical data from all sources. Dynamic command and control is central to increasing the capabilities of airpower. Increases in capability will arise primarily from the ability to collect, analyze, and use information to make critical decisions to engage the enemy quickly and decisively—in short, to maximize the effect on the enemy within the constraints imposed. Certain functions are crucial: timely information, timely decisions, proper assignment of tasks to computers and automation, and proper synchronization.[5] Without a determined effort to manage this generation, distribution, storage, fusion, and presentation of information to support timely decision making, airpower of the 21st Century will be data rich, information ragged, and decision poor.

The future holds the promise of combining sensor arrays, targeting systems, weapons delivery capabilities, and command and control methods in a number of ways to allow maximum flexibility for the JFACC. For this concept, for those above, and for RTIC in general, the devil is not so much in the details, but in the decision—the decision to prioritize these capabilities and make the investments required to bring ideas into reality.

Notes

1. Frank Oliveri, "Upgrades for Killing Launchers Studied," *Air Force Times* (22 January 96): 26.
2. "New World Vistas: Air and Space Power for the 21st Century," Sensors Volume (Undated draft), iv.
3. Ibid., v.

Notes

4. The New World Vistas' sensor and attack volumes provide excellent discussions of potential advances in sensors, weapons and weapons platforms, command and control, and the functional integration of all three.

5. "New World Vistas: Air and Space Power for the 21st Century," Attack Volume (Undated draft), 7.

Glossary

5D	Demand Driven Direct Digital Dissemination (pg. 50)
ABCCC	Airborne Command, Control, and Communications (pg.s 1, 4, 19, 53)
ACE	Airborne Command Element (pg. 53)
AFTENCAP	Air Force Tactical Exploitation of National Capabilities (pg. 29)
ALERT	Attack and Launch Early Reporting to Theater (pg. 23)
AOC	Air Operations Center[1] (pg.s iv, 1, 4, 5, 10, 16, 17, 18, 25, 30, 32, 39, 40, 43, 50)
APS	Automated Planning System (pg. 38)
ASARS	Advanced Synthetic Aperture Radar System (pg. 7)
ATM	Air Tasking Message (pg. 7)
ATO	Air Tasking Order (pg.s v, vi, vii, 4, 10, 15, 16, 17, 18, 30, 31, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 52)
AWACS	Airborne Warning and Control Systems (pg.s 4, 19, 22, 24, 47, 53)
BAI	Battlefield Air Interdiction (pg. 36)
BCE	Battlefield Coordination Element (pg. 53)
BDA	Battle Damage Assessment (pg.s 17, 30, 35, 36, 46, 47, 57)
C^2	Command and Control (pg.s 2, 3, 4, 5, 14, 15, 16, 19, 30, 31, 35, 36, 53, 55, 57)
C^4I	Command, Control, Communications, Computers, and Intelligence (pg.s vi, 5, 9, 18)
CAF	Combat Air Force(s) (pg. 56)
CAFMS	Computer-Assisted Force Management Systems (pg. 38)
CARS	Contingency Automated Reconnaissance System (pg. 26)
CAS	Close Air Support (pg.s 36, 57)
CCO	Chief of Combat Operations (pg.s 40, 42, 45)
CIC	Combined Intelligence Center (pg. 54)
CID	Combat Intelligence Division (pg. 17)
CIEF	Combined Imagery Exploitation Facility (pg.s 6, 54)
CINC	Commander in Chief (pg.s 28, 34)
COG	Center of Gravity (pg. 12)
COMINT	Communications Intelligence (pg.s 22, 26, 27)
CTAPS	Contingency Theater Automated Planning System (pg. 18)
CTL	Candidate Target List (Facilities Level) (pg. 38)
DARO	Defense Airborne Reconnaissance Office (pg. 25)

DARPA	Defense Advanced Research Projects Agency (pg. **Error! Bookmark not defined.**)
DCO	Director of Combat Operations (pg. 54)
DIEPS	Digital Imagery Exploitation Production System (pg. 50)
DMPI	Designated Munitions Point of Impact (pg.s 38, 51)
DMSP	Defense Meteorological Satellite Program (pg.s 22, 23)
DSP	Defense Support Program (pg.s 1, 6, 22, 23, 47, 56)
ELINT	Electronics Intelligence (pg.s 22, 24, 26, 27, 28, 49, 52)
EO	Electro-Optical (pg.s 22, 25)
FLIR	Forward Looking Infrared (pg. 23)
GAT	Guidance, Apportionment, and Targeting (pg. 38)
HF	High Frequency (pg.s 19, 51)
HUMINT	Human Intelligence (pg.s 22, 27, 28, 52)
IDEX	Imagery Data Exploitation (pg. 50)
IMINT	Imagery Intelligence (pg.s 22, 52)
IN	Intelligence Threats Representative in the AOC Combat Operations RTIC Cell (pg.s 42, 43)
IP	Initial Point (pg.s 41, 48, 53)
IPB	Intelligence Preparation of the Battlespace (pg. 11)
IR	Infrared (pg.s 22, 23, 24, 25, 26, 31, 43, 47, 48, 50, 52, 56)
ITO	Integrated Tasking Order (pg. 7)
JFACC	Joint Force Air Component Commander (pg.s vvi, vii, 1, 2, 3, 4, 5, 9, 10, 11, 12, 14, 15, 16, 17, 29, 30, 32, 35, 36, 44, 45, 53, 55, 58)
JFC	Joint Force Commander (pg.s 1, 4, 9, 10, 11, 12, 13, 14, 15, 17, 23, 28)
JGL	JFACC's Guidance Letter (pg. 38)
JIPTL	Joint Integrated Prioritized Target List (pg.s 15, 45)
JSTARS	Joint Surveillance Target Attack Radar System (pg.s 1, 6, 19, 22, 24, 48, 56)
JTAGS	Joint Tactical Ground Station (pg. 23)
JTCB	Joint Targeting Coordination Board (pg. 14)
JTIDS	Joint Tactical Information Distribution System (pg.s 24, 51)
LANTIRN	Low-Altitude Navigation and Targeting Infrared for Night (pg.s 2, 23)
MAAP	Master Air Attack Plan (pg.s 10, 15)
MATT	Multi-mission Advanced Tactical Terminals (pg.s 51, 52)
MC	Mission Coordinator in the AOC Combat Operations RTIC Cell (pg.s 42, 43)
MP	Aircraft-specific Mission Planner in the AOC Combat Operations RTIC Cell (pg.s 42, 43)
MTI	Moving Target Indicator (pg.s 6, 22, 24, 25)
MTR	Military Technical Revolution (pg. v)
NCOIC	Non-Commissioned Officer In Charge (pg. 6, 54)
NRT	Near Real-Time (pg.s 5, 22, 23, 29, 43, 49, 50, 52)

PGM	Precision Guided Munition (pg. 47)
PI	Photo Interpreter in the AOC Combat Operations RTIC Cell (pg.s 42, 43)
PRF	Pulse Repetition Frequency (pg.s 42, 43)
QC	Quality Check (pg. 38)
QRC	Quick Reaction Capability (pg. 30)
RD&A	Research, Development, and Acquisition (pg. 30)
RF	Radio Frequency (pg.s 27, 56)
ROE	Rules of Engagement (pg. 50)
RSTA	Reconnaissance, Surveillance, and Target Acquisition (pg.s 22, 24)
RTB	Return To Base (pg. 41)
RTIC	Real-Time Information into the Cockpit (pg.s v, vi, 1, 2, 3, 4, 5, 6, 19, 21, 23, 25, 27, 28, 29, 30, 31, 32, 37, 41, 42, 43, 45, 46, 47, 52, 55, 56, 57)
RTOC	Real-Time Information Out of the Cockpit (pg.s 29, 57)
RTSMP	Real-Time Symmetric Multi-Processor (pg.s 49, 52)
SAR	Synthetic Aperture Radar (pg.s 6, 22, 24, 25, 50, 52, 56)
SATCOM	Satellite Communications (pg.s 19, 24, 51)
SCDL	Surveillance and Control Data Link (pg. 24)
SEAD	Suppression of Enemy Air Defenses (pg.s 27, 28, 47)
SHF	Super High Frequency (pg. 51)
SIGINT	Signals Intelligence (pg.s 22, 24, 25, 27, 48, 49, 52)
SJA	Staff Judge Advocate (pg. 16)
SODO	Senior Operations Duty Officer (pg. 40)
SPINS	Special Instructions (pg. 15)
SYERS	Senior Year Electro-optical Reconnaissance System (pg. 25)
TACC	Tactical Air Control Center (pg. 7)
TACDAR	Tactical Detection and Reporting (pg. 23)
TACS	Theater Air Control System^2 (pg.s 5, 18, 44)
TADIL	Tactical Digital Information Link (pg.s 19, 49, 51, 57)
TADIX	Tactical Data Information Exchange System (pg. 51)
TBM	Theater Ballistic Missile (pg.s 23, 28, 44, 47, 55, 56)
TCT	Time Critical Target, Time Critical Targeting (pg. 36)
TEL	Transporter, Erector, Launcher (pg.s 2, 28, 48)
TENCAP	Tactical Exploitation of National Capabilities (pg. 23)
TES	Tactical Event System (pg. 23)
TIBS	Tactical Information Broadcast Service (pg.s 24, 47, 48, 49)
TMD	Theater Missile Defense (pg. 55)
TNL	Target Nomination List (DMPI Level) (pg. 38)
TOT	Time On Target (pg.s 31, 53)
TPW	Target Planning Worksheet (pg. 38)
TRAP	Tactical Receive Equipment and Related Applications (pg.s 24, 47, 49)
TRE	Tactical Receive Equipment (pg. 51)

UAV	Unmanned Aerial Vehicle (pg.s 22, 25)
UHF	Ultra High Frequency (pg.s 19, 25, 51)
USIS	United States Imagery System (pg. 33)
USSPACECOM	United States Space Command (pg.s iii, 23)
VHF	Very High Frequency (pg.s 19, 51)
WX	Weather Representative in the AOC Combat Operations RTIC Cell (pg.s 42, 43)

Notes

1 Sometimes referred to as the Tactical Air Control Center during Operations Desert Shield and Storm.

2 Known as the Tactical Air Control System during the Operations Desert Shield and Storm.

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